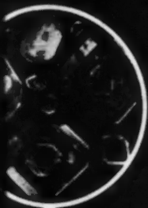
CHEMISTRY



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Let Me Show You
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25¢

Let Me Show You

➤ CHEMISTRY is pre-eminently a spectacular science. Astronomers may point to the vast panorama of the heavens. Physicists may impress us with their measurements of the infinitely small. Biologists may confront us with the mystery of life processes. All these sciences are marked by apparent stability of the phenomena we see. Our minds are amazed when we learn of the enormous activity going on just beyond our limits of perception in what seems like quiet Nature.

It is reserved for the chemist to have things blow up in his face, assault his ears with loud bangs, his nose with peculiar smells, his eyes with flames and colors like nothing ever seen before. No wonder his neighbors have frequently looked askance at his strange choice of work, and labelled it a Black Art.

The chemist keeps trying to explain. And, because everybody loves a good show, the explainer often borrows a few tricks from his disreputable ancient relative, the alchemist, and mixes a little sleight-of-hand with his demonstrations, to make the audience happy. There is always the chance that some of the audience will learn some chemistry from these demonstrations, and even, perhaps, want to learn some more. Sir William Ramsey first took up the study of chemistry to learn how to do tricks.

There are a number of fairly well-known chemical demonstrations and stage effects which can be used effectively for show purposes. They form a body of literature which is familiar but hard to locate just when one wants it. The staff of CHEMISTRY has compiled directions for some of these experiments and added a number of original twists concerning their presentation.

This big combined summer issue of CHEMISTRY comes to you next month as the SHOW BOOK number, a hand-book for chemists who like to show what they can do.

CHEMISTRY

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Including The Science Leaflet

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Consulting Editor: PAULINE BEERY MACK (Editor 1927-1944)

➤ BACTERIAL *fermentation plays a part in the production of unusual sugars in this laboratory at the National Institutes of Health.*

Chemicals of Life

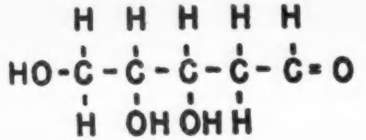
by HELEN M. DAVIS

➤ CHEMICAL REACTIONS on which life depends are yielding one by one to scientific investigators. And the most mysterious part of the still-unexplained secret of living processes is the relative simplicity of life reactions.

Proteins, fats and sugars, which make up a balanced diet, are represented in the chemicals of the body which they nourish. Within remarkably wide limits these chemicals can substitute for each other, for the life process consists largely of taking apart one kind of organic chemical and rebuilding its chemical constituents into another material not too different from the first.

One chemical that turns up persistently in the products of life processes is desoxyribonucleic acid. In spite of its long name, it is complex only because it is made up of a large number of different units joined together. The units are simple, as organic compounds go, and are met in many natural substances. Many of them are standard parts in Nature's factory.

Chemical names are hitched together like a train of cars. Uncoupling



2-desoxyribose

the name *desoxyribonucleic acid*, the *nucleic acid* describes a typical standard-part chemical, a nitrogen-containing material widely distributed in living matter. The *ribo-* part refers to a simple sugar, *ribose*, containing five carbon atoms. The prefix *desoxy-* means that the sugar has fewer hydroxyl groups than carbon atoms.

Desoxyribonucleic acid has recently been found to be one of the actual chemical factors of inheritance. This discovery, which may prove to be a significant step toward the solution of the secret of life, was made by Dr. A. E. Mirsky of the Rockefeller Institute for Medical Research.

Dr. Mirsky made his discovery through analysis of chromosomes, the slender rodlike bodies, in the nuclei of living cells, which contain the genes.

All cells contain two sets of genes, except the sex cells. These reproductive cells each have only one set of genes. And purified chromosomes of the male cells, Dr. Mirsky found, contain only half as much desoxyribonucleic acid as other cells of the same animal. This proves, he said, that the chemical is a constituent of the genes. It may not be the only one, but no other compound has yet been identified.

The quantity of the chemical is identical for each cell in a given animal species, although it may vary from one species to another. Different types of cells, because they vary in weight, contain different proportions of the chemical, but the absolute amount is fixed for any animal species.

Genes, besides their part in inheritance, are known to play an important role in the life processes of cells. They are thought by some scientists to serve as master die patterns for enzymes, the complex biological compounds which control all the body's chemical activity.

Throughout the plant as well as the animal worlds, enzymes control reactions, especially those involving breakdown and rearrangement of carbohydrates. The nature of each enzyme is remarkably specific, so that sugar and enzyme go in pairs, reminding one of the action of lock and key. Corresponding names are given them, as *maltase*, the enzyme for *maltose*, the sugar.

Desoxyribo-nucleic acid, the compound of the sugar *ribose* with nucleic acid, is a typical chemical of the life processes. It is one of a large class of materials known as glycosides—two-part molecules that split to release sugar.

The syllable *gly-* refers to sugar. The rest of the molecule, that is not sugar, is called the *aglycon*. The subclass of glycosides whose aglycons are the nucleic acids are called nucleosides.

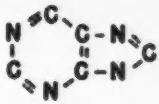
All the nucleic acids in the desoxyribose nucleosides seem to be built of two kinds of nitrogen-containing compounds, pyrimidines and purines. The structure of pyrimidine is a benzene ring in which nitrogen replaces two of the carbon atoms. The purine mole-

cule has the same ring with a side ring of two additional nitrogen atoms and one carbon joined to it. Methyl groups, amino groups and others of the sort can replace the hydrogen atoms around the ring in these structures, so that a variety of detail is possible in the individual compounds, but the basic design is simple.

In the living organism, different kinds of nucleosides are believed to be hooked to one another by phosphoric acid groups. It is in this way that the molecules become complex although the variety of standard parts in any one kind of organism may not be great.

Although ribose plays such an important part in cell structure, it is by no means the only sugar necessary to life. Glucose is the key sugar in animal metabolism. It is synthesized and stored in the liver, carried by the blood-stream to the muscles, and there oxidized to lactic acid. The lactic acid, returned to the liver, is rebuilt into

Pyrimidine nucleus

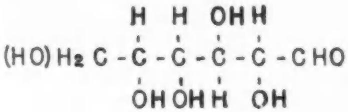


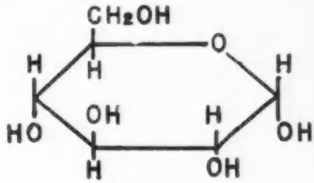
Purine nucleus

glucose. Much of the body's defense against poisoning lies in the liver's ability to convert unwanted material into useful glucose, as well as to discard unusable material.

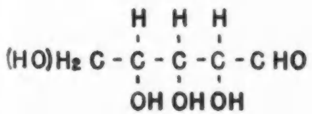
Even in plants the same mechanism seems to be at work. Certain parts of the leaves have the ability to form glycosides and wall them off from the rest of the plant. It is believed that in many cases these are by-products that would poison the plant if this arrangement did not dispose of them.

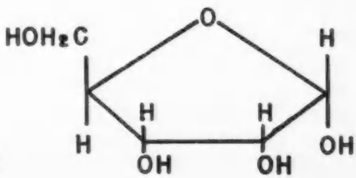
Other glycosides with their appropriate enzymes play an important part in the life processes of plants, such as in the ripening of fruit. Considering the poisonous properties of so many of the glycosides, warnings





Glucose, chain and ring forms





Ribose, chain and ring forms

against eating unripe fruit can be recognized as having a serious basis. One especially dangerous substance of this class is amygdalin which occurs in peach, apricot and bitter almond plants. Amygdalin splits into two parts of glucose accompanied by one part each of benzaldehyde and hydrogen cyanide.

Specific action of some glycosides on certain organs of the body has long been known, and led to their early use as medicines. One well-known example is digitalis, prepared from the foxglove plant for use as a heart stimulant. This is the best known of a group called the cardiac glycosides. Other members of this group have been used as arrow poisons.

Similar and closely related plant glycosides are the saponins. They make foamy solutions in water. Many primitive people use them in place of soap, and also as fish poisons. Because the saponins are not absorbed from the human intestinal tract, the fishermen can eat the fish that have been killed in this way.

Other familiar glycosides are vanillin from the vanilla bean, and the similar flavor of more complex structure, coumarin, from a number of plants. Sarsasaponin is a soapy glycoside from sarsaparilla.

Chemically, the process of splitting a glycoside is much the same as hydrolysis. It can sometimes be effected by acids, alkalies or boiling water. In other cases it occurs as the result of bacterial or yeast fermentation. Chemists are making increased use at the present time of these biological processes to produce unusual kinds of organic compounds for particular purposes. Some bacteria have astonishing ability to distinguish between optical isomers, consuming one form but leaving untouched its twin whose molecular structure is the mirror image of the kind the bacterium prefers.

Exploitation of glycoside reactions is likewise the basis of many ancient folk arts. One of the most widespread of these is the art of dyeing. Many of the red and blue pigments of plants, flowers and fruits have been used for this purpose. The best known examples are indigo and madder.

Again, in one of the newest fields of research, the antibiotic streptomycin, isolated from a soil organism by Waksman and his associates, turns out to be a glycoside of a unique type. In its molecule nitrogen-containing groups, which are unusual in glycosides, are attached to the C_5O ring structure, which is typical of many sugars.

The empiric sugar formula, $C_6H_{12}O_6$, is misleading in its symmetry. In its simplest arrangement, this formula applies, not to a sugar, but to the nine possible isomers known by the group name of inositol. Inositol again gives evidence of the inter-relatedness of the life chemicals by appearing among the group of potent substances in vitamin B.

The molecular structure of inositol is a six-membered carbon ring which differs from a benzene ring in having the carbon atoms joined by single bonds. Each carbon atom holds one hydrogen atom and one hydroxyl group. They may be thought of as standing up like a picket fence around the ring, for the existence of nine isomers shows that there is a difference in the resulting compound de-

```
  thymine            O        adenine            O
     |               ‖           |               ‖
- 2-desoxyribose - O - P - O - 2-desoxyribose - O - P - O -
                       |                             |
                       OH                            OH


  cytosine           O        guanine            O
     |               ‖           |               ‖
  2-desoxyribose - O - P - O - 2-desoxyribose - O - P - O -
                       |                             |
                       OH                            OH
```

➤ Four *desoxyribonucleic acid groups linked by phosphoric acid residues occur in a repeating pattern to build up living tissues, according to present understanding gained from analysis of their break-down products.*

pending on which side of the plane of the carbon ring these groups happen to be attached.

The six hydroxyl groups give inositol the reactive properties of an alcohol. It is found in great abundance throughout the plant and animal kingdoms. Sometimes it is free, sometimes it is combined with the phosphate groups which are so important in life processes, although as yet so little understood.

We do not know exactly how a molecule of inositol changes into one of sugar, although there is no doubt about the structure of either. Sugar molecules are also six-member rings, but one of the six members is oxygen, which has apparently pushed one of the carbon atoms into a side position.

The remaining atoms of oxygen and hydrogen distribute themselves around the carbon atoms according to the usual laws of valence, and give rise to isomeric aldehydes, ketones and related compounds according to all the possible permutations and combinations.

But this by no means exhausts the sugars. Nearly everybody knows that sugar is a sweet, crystalline substance, obtained from a tropical plant, and that its formula is either $C_6H_{12}O_6$ or $C_{12}H_{22}O_{11}$. But there are plenty of un-sweet, non-crystalline sugars from the temperate zone which may be products of animals, of insects or of plants quite different from sugar cane.

Many of these little-known sugars occur in nature as glycosides. The general pattern of the sugar part of their molecules fits them into the carbohydrate series as compounds simpler than starches and cellulose but more complex than cane sugar. They are known as oligosaccharides, from the Greek prefix meaning "a few."

The Greeks speculated about government by an "oligarchy," meaning a few selected individuals. The sense in which the prefix is borrowed by

the sugar chemist refers to a few simple sugar groups per molecule, more than two but in general less than ten. It does *not* mean a few kinds of sugars. By the time one considers all possible linkages, in three dimensions, which give rise to optical isomers in the sugar molecule, the varieties of the oligosaccharides may well run to staggering numbers.

As we have seen, these researches lead down many branching paths. They encompass primitive arts and modern antibiotics, chromosomes and vitamins, nutrients and poisons, the constitution of cockroach shells and the virtures of left-handed bacteria.

Yet the pattern is simple, and with radioactive tracers available the chemists can follow the shifting rearrangements of organic chemicals that are the processes of life.

On the Back Cover

➤ SUGARS *from everywhere appeared in this recent exhibit arranged by the National Institutes of Health at Washington, with the natural material from which the sugars were obtained. A common wild flower appears as a sugar source along with corncobs, seaweed, avocados and household yeast. Of especial interest is sugar of animal origin, represented by the chitin of the crab shell. The same material can be found in the outer coverings of cockroaches and other insects. This photograph and that on page 1 are by Fremont Davis, Science Service Staff Photographer.*

Structures of the Vitamins

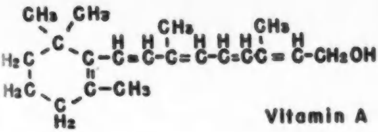
➤ VARIETY is the most striking feature of the formulas on the opposite page, representing Vitamins A and C and the ten Vitamin B formulas whose structures are best known. Inositol, simple carbohydrate-like material, appears among the Vitamin B chemicals.

Vitamin C has a ring structure very similar to that of the sugars. In fact, ascorbic acid can be synthesized from certain sugars with the aid of a remarkable germ, *acetobacter suboxydans*. This bacterium is able to make use of compounds whose molecules have one definite arrangement. Optical isomers of these compounds, in which the same groups of atoms have the opposite arrangement in space, are of no use to this highly specialized organism.

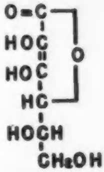
Nitrogen appears in the ring structure of some of the B-complex chemicals, sulfur in others. Not all the compounds shown here are essential in human diet, although all are necessary to one or another of the laboratory animals used for nutrition studies.

Lacking diet factors can often be synthesized by the body from the chemicals available, so that the exact kinds and amounts of the vitamins that are required are often difficult to determine. There are other chemical entities in the B-complex, also, whose precise constitution has not been completely worked out.

Vitamin Formulas Show Varied Structures

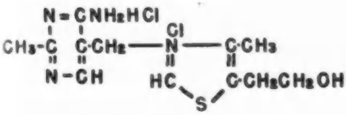


Vitamin A

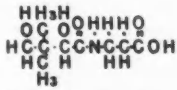


L-Xyloascorbic acid-Vitamin C.

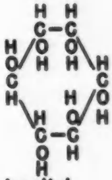
10 Chemicals from Vitamin B



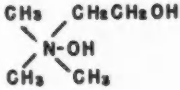
Thiamine hydrochloride



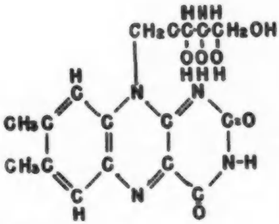
Pantothenic acid



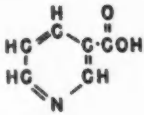
Inositol



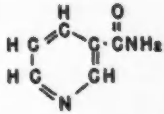
Choline



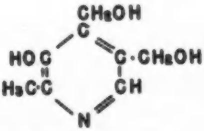
d-Riboflavin



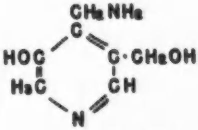
Niacin



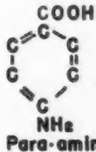
Niacin amide



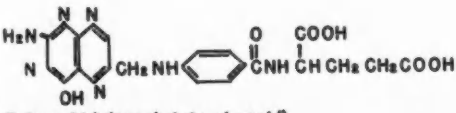
Pyridoxine



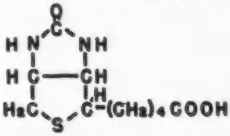
Pyridoxamine



Para-amino benzoic acid



Folic acid (pteroylglutamic acid)



Biotin

Chloromycetin Made Chemically Now in Clinical Use

Synthetic Antibiotic

➤ For the first time in history a disease-curing mold chemical, or antibiotic drug, similar to penicillin, has been synthesized on a practical basis.

The drug is chloromycetin, which has been curing scrub typhus and other kinds of typhus fever, typhoid fever, Rocky mountain spotted fever, undulant fever, virus pneumonia, whooping cough, Friedlander's pneumonia and some other germ infections.

The synthesis was achieved by reseach chemists at Parke, Davis and Company in Detroit where production of the drug from the mold has been going on for about two years.

Penicillin, first of the antibiotic drugs, was synthesized after years of intensive efforts by teams of scientists here and in England. But this synthesis was a laboratory feat not suitable for production of usable quantities of the drug.

The chloromycetin synthesis is on a practical large-scale production basis. Park, Davis and Company are now producing the drug by the fermentation process from the mold and by the synthetic process. The synthetic chloromycetin has been named Chloramphenicol.

Both kinds of chloromycetin are now on the market. Originally the supply was so small that it could only be used for clinical trials by a limited number of physicians. But with two kinds of production going, the manufacturers have been able to release it through regular channels, though this has been done so recently that drug stores in some communities may not yet have supplies.

With two ways of making the drug, it is hoped that the price will soon drop. At present, the best price, to institutions such as hospitals, is somewhat over $2 per gram. At retail drug stores it may sell for considerably more. Doctors now use from eight or nine to 20 grams for each patient treated. With more experience they may find that less of the drug is needed. Right now, they give maximum amounts to avoid relapses or failures to get the patient well.

A pretty, 28-year-old woman chemist, Dr. Mildred C. Rebstock of Parke, Davis and Company, has the distinction of being the first person in history to synthesize any of the antibiotic, or germ-against-germ drugs in a way that makes commercial production possible.

She picked up the work, after men research chemists at Parke, Davis had failed, and succeeded in producing the synthetic product. She is a graduate of North Central College, Illinois, received her Ph.D. in chemistry at the University of Illinois, and has been on the Parke, Davis research staff four years.

Chloromycetin was first discovered in a mold organism from a sample of soil from Venezuela. The mold organism has been named Streptomyces venezuelae. When the mold-produced drug had shown its value as a cure

for scrub typhus, epidemic typhus, typhoid and Rocky Mountain spotted fevers, Dr. Harry M. Crooks, Jr., at Parke, Davis was asked to coordinate the project of finding a way to produce synthetic chloromycetin on a practical basis.

First he, with Dr. Rebstock, John Controulis and Dr. Quentin R. Bartz, worked out the chemical structure of the chloromycetin molecule. Then Mr. Controulis, in a remarkably short period of time, developed a synthetic method of production.

Unfortunately, the arrangement of the atoms in his synthesized product was wrong and the chemical was not active against disease germs. The work was then turned over to Dr. Rebstock, who developed the method for practical synthesis of the active drug. Tests by Army scientists confirmed the Parke, Davis tests showing that the synthetic and mold-produced drugs are alike in their action against the disease germs.

Chloromycetin, unlike penicillin and streptomycin, is effective when given by mouth, and its toxicity is of a very low order. So far, no reports of any serious side-effects have been made.

In the process of making the synthetic drug, several surprising facts about it were discovered. For the first time a natural compound was found containing a nitro-benzene grouping. This chemical grouping has always been thought harmful to animal life, but in chloromycetin it is harmless. The chemists also found that the drug is a derivative of dichloroacetic acid, another compound never before found in a natural product. Its chief medical use in the past was for the removal of warts. Thus by two counts the mold-drug should have been toxic but is not.

Chemists now are working on preparation of closely related structures which may have even wider usefulness in medicine than chloromycetin itself. Two other Parke, Davis chemists, Dr. Loren M. Long and Harvey Troutman have developed a second feasible method of making chloromycetin commercially on a large scale.

Chemically, chloromycetin or chloramphenicol is D-threo-1-paranitrophenyl-2-dichloroacetamide-1,3-propanediol.

The mold that makes chloromycetin has been christened Streptomyces venezuelae. The first word of the name shows the class of molds to which it belongs, which incidentally is the same as that which produces streptomycin. The second word is in honor of the country, Venezuela. It was in a sample of soil from this South American nation that Dr. Paul R. Burkholder of Yale University discovered chloromycetin. Dr. Burkholder, working under an arrangement with Parke, Davis and Company had been testing hundreds of soil samples from all over the world in a search for new antibiotic drugs.

First use of the drug was, appropriately enough, in Venezuela's sister country, Bolivia. A typhus epidemic had broken out and Parke, Davis was asked by the Bolivian health officials if they had any drug that would help. They got together all the chloromycetin they had, amounting to a few grams, and Dr. E. H. Payne of the company flew down with it. The first 40 patients

treated all got well, whereas 20 of the 50 previous typhus victims had died.

Because scrub typhus, or tsutsugamushi disease, had been a worry to the Army during the Pacific phases of the war, next trials of chloromycetin were made by Dr. Joseph H. Smadel of the Army Medical Department in Kuala Lumpur. There it proved its effectiveness against this disease and also against typhoid fever.

Hope that chloromycetin might become a cure for the common cold has been raised by its effectiveness in some virus diseases. A few physicians have tried it and reported good results, but there have been no scientifically controlled trials of it in colds as yet. The manufacturers doubt whether it will prove effective in either colds or that other virus-caused plague, for which a remedy is still badly needed, infantile paralysis.

For diseases in which the drug is effective, the response comes, as one doctor puts it, "with monotonous uniformity," within two to three days. This response is so uniform that doctors now feel they can use it to test the drug's effect in diseases for which it has not yet been tried. If the patient is not getting well by the third day, the drug is not going to be effective in his particular disease.

Water Freezes Below Freezing-Point

➤ WATER does not freeze at freezing-point but at a considerably lower temperature. Really pure, clean water, free of particles that might serve as nuclei or starting-points of freezing, does not begin to crystallize into ice at zero Centigrade (32 degrees above zero Fahrenheit) but at zero Fahrenheit or a little below it.

This upset of one of the standard "facts" of all physics books comes as the result of a series of very carefully conducted experiments by Dr. Robert Smith-Johannsen, in the research laboratories of the General Electric Company.

Carefully prepared, absolutely clean water was chilled in a specially built apparatus, and the first formation of ice was detected through the use of polarized light. Four sets of experiments produced first ice at temperatures ranging from 18 to 20 degrees Centrigrade below the traditional freezing-point, or from about one-half degree to four degrees below zero on the Fahrenheit scale.

Various powdered substances, ranging from graphite to pepsin, were added to the water as freezing nuclei. Even then nothing was found that would cause water to freeze at the "freezing-point." Most of the powders did raise the freezing temperature of the water, but none got it closer than about seven degrees below zero Centigrade, or approximately 20 degrees above zero Fahrenheit.

A lacquer made from milk has been developed as a substitute for tin coating on cans used for evaporated and condensed milk; it is made largely from lactic acid, with a small proportion of castor or other vegetable oil.

Allergy Remedy Tames Old Foe

Drug For Seasickness

➤ A SYNTHETIC chemical made to relieve hayfever, hives and other allergies has turned into what seems the best remedy and preventive yet found for seasickness and other forms of motion sickness. The chemical is called Dramamine. A lucky accident revealed its anti-seasickness possibilities and an Army sponsored experiment proving them was reported by Drs. Leslie N. Gay and Paul Carliner of the Johns Hopkins Hospital.

When the drug was on trial at the hospital's allergy clinic, it was given to a woman with hives who incidentally had suffered all her life from carsickness. Unexpectedly, the carsickness was relieved as well as the hives. The drug gave complete relief if the woman took one capsule a few minutes before boarding a streetcar.

The Hopkins scientists then tried it on other patients who got carsick or airsick. They were all completely free of discomfort if they took the drug just before getting on car or plane.

Seasickness trials were made last summer on the U.S.S. America. They were so encouraging that the drug was reported to the Chief of Staff and the Surgeon General of the Army. Seasickness was an especial problem to the Army during the war. Many drugs were tried but those apparently successful produced other symptoms as seriously handicapping as the motion sickness itself. Dramamine is without this disadvantage.

A special study of seasickness was carried out on the Army transport General Ballou during a voyage from New York to Bremerhaven last December with 1,376 men aboard. The Ballou, built originally for the Pacific, was chosen because its narrow, high construction promised a rough midwinter Atlantic crossing with the likelihood of much seasickness.

One group of men was given the drug as a preventive. They got a capsule as the ship left the harbor, six hours later and then before each meal and before retiring. Less than two percent who got the preventive doses developed seasickness. Of those given the drug to cure seasickness after it had developed, all but three percent got complete relief.

Dramamine is not yet available commercially. It is made by the G. D. Searle and Co. of Chicago. Its full chemical name is beta-dimethylaminoethyl benzohydryl ether 8-chlorotheophyllinate.

First Congress on Biochemistry

➤ THE WORLD'S first congress of biochemistry will be held this summer, Aug. 19 to 25, at Cambridge University. From many countries investigators in living processes of chemistry will report their latest findings and exchange information with workers in other laboratories.

Some Reports from Spring Meeting of the American Chemical Society

ACS San Francisco

Some of the highlights of the important meeting of the American Chemical Society in March are given in these articles.

Carbon Monoxide Neutralized

➤ A PREVENTION against poisoning by carbon monoxide gas in garages, aircraft, submarines, factories, mines and other places was revealed by Dr. Morris Katz and Sophie Halpern of the Canadian Department of National Defense, Ottawa. It utilizes a new chemical powder which neutralizes the gas.

The new powder contains silver permanganate as the active agent. This is coated on minute particles of so-called carriers when it becomes highly effective and notably long-lived in the temperature and humidity ranges generally encountered in the temperate and tropical climates, they declared. In addition to use in gas masks, the powder can be placed in ventilating and air-conditioning systems to clean large volumes of air.

Dry silver permanganate by itself shows virtually no activity toward carbon monoxide, they stated. But when it is coated upon a suitable carrier, it can remove all the carbon monoxide from a rapidly moving stream of air at normal temperatures and humidity. In the process described, the silver permanganate is used as a coating on granules of various metallic oxides, clay, talc, or purified asbestos fiber.

"Man-Made" Seaweed

➤ COOLER SUMMER clothes may come in the future from using man-made seaweed.

The synthetic seaweed fibers have been used to weave very light, delicate woolen and cotton materials. This new process was described by Drs. J. David Reid and George C. Daul of the U. S. Department of Agriculture's Southern Regional Laboratory in New Orleans.

Seaweed-like fibers are prepared from wood, cotton or other forms of cellulose. They are spun in much the same way as rayon or nylon. These fibers are woven into a fabric and later washed out by soapy water to produce fluffy and porous materials.

It also is possible to weave the man-made seaweed fibers into special patterns which give unique, novelty fabrics when dissolved out.

Fluffier fabrics made by this dissolving-out method could be used for such things as summer suits, men's undershirts, ladies' blouses or lace curtains.

Vinegar Rubber

➤ RUBBER is made out of vinegar—or at least out of the chemical compound that is the essence of vinegar.

Steps in the formation of rubber in the guayule plant that grows in the American Southwest were traced by

means of "tagged" radioactive atoms by Dr. James Bonner of the California Institute of Technology.

The chemical group that is the essence of vinegar is known technically as the acetate molecule. In the experiments, such molecules were "tagged" with radioactive carbon atoms, then fed to guayule plants. Very soon the bits of rubber in their stems were found to be radioactive. Progressive steps in the buildup of rubber (and related gums) were described by Dr. Bonner as: acetate, acetone, beta-methylcrotonic acid, rubber.

Tracer for Plants

➤ The techniques of tracing through a plant any given element or compound that has been radioactively tagged were described before the meeting by Dr. Melvin Calvin of the University of California. The radioactive material is supplied to the plant, to be absorded through roots, leaves or otherwise. After a measured time interval the plant is suddenly killed, so that movement of any materials in its body is promptly stopped right where it is. Then parts may be removed for analysis or for detection of radioactivity with Geiger counters or photographic film.

Hypersorption Process

➤ Light gasses, which are building blocks for such products as antifreezes, fertilizers and margarine may become cheaper and more plentiful as a result of a new method of petroleum gas separation.

The new process, known as hypersorption, was described by Clyde Berg of the Union Oil Company of California. The hypersorption unit is a tall, round column with a cooler at the top and a steam section at the bottom. Between these two are very fine particles of charcoal. This has been treated so that it will absorb the heavy gases in larger quantities than the light gases.

The method was first used to produce ethylene, from which glycol antifreezes and ethyl alcohol are made. This process can also be applied to recover hydrogen from catalytically cracked gases. Hydrogen is used in the production of margarine, of ammonia fertilizers and of many plastics. Propane, which is burned in many homes as bottled gas, can be produced more cheaply and efficiently from natural gas by this new process.

One Step Gasoline

➤ Getting high-grade gasoline from low-grade crude oil can now be done in a single step, two scientists from the Esso Standard Oil Company Laboratories, Baton Rouge, La., Dr. Alexis Voorhies, Jr., and W. M. Smith explained. The process removes sulfur from the oil with hydrogen gas at relatively low pressures. Previous, more costly methods used hydrogen at high pressures.

Gas Sulfur Test

➤ Just how much trouble sulfur can cause in the gas you use in your car has been measured by a team of DuPont chemists. H. K. Livingstone, J. L. Hyde and M. H. Campbell reported that only one-tenth of one percent of sulfur of the kind found in most gasoline will ruin the effect of half of the tetraethyl lead, added to prevent knock in your motor.

New Insecticides

➤ BNB and BNP are new insect-kill-

ers which can control insects that survive DDT.

Dr. Henry B. Hass, of General Aniline and Film Corp., and formerly of Purdue University, synthesized the chemicals in collaboration with two Purdue graduate students, Drs. M. B. Neher and R. T. Blickenstaff. Dr. Walter O'Kane of the University of New Hampshire conducted tests of the new insecticides. The studies showed that BNB and BNP were only one-third as poisonous to mice as DDT. These newest weapons in the anti-insect arsenal are only two of hundreds of nitro paraffin chemicals which are being investigated.

New Alcohol

➤ Dr. W. M. Bruner of Du Pont said that a new alcohol trimethylhexanol, made from coal petroleum, air and water, yields many chemical compounds. Some of these may be used in industry as synthetic lubricants, wetting agents and other applications.

Chemicals From Acetylene

➤ Chemicals from acetylene are being made at Grasselli, N. J. under high pressures and temperatures with safety in a new plant opened by The General Aniline and Film Corporation of New York. It is the first establishment of its kind in the United States.

Acetylene, long known to chemists for its wide versatility but little used because of its explosiveness under pressure, can now be exploited with safety as a result of new techniques. A whole new field of organic synthesis is opened up which should prove of intense interest in the manufacture of resins and adhesives, pharmaceuticals, paper, rubber and textiles.

The technique used is based on processes developed in Germany during the war. Briefly it consists of two methods, one involving the dilution of acetylene with an inert gas, and the other one in which acetylene is reacted in what is essentially small-bore equipment providing a minimum space for gases to collect.

With a shortage of hydrocarbons, the Germans during the war were compelled to find new raw materials for essential wartime chemicals especially for the production of synthetic rubber, pharmaceuticals and synthetic fibers. Derivatives of high-pressure acetylene answered these needs and played a vital role in Germany's ability to carry on for nearly six years.

The high reactivity of acetylene under pressure makes it perhaps the most versatile tool available to the organic chemist. Because it is so new, it is impossible to predict with much hope of accuracy the full extent to which acetylene derivatives may contribute to future economy.

Acetylene is a well known gas easily made by adding water to calcium carbide. Uncontrolled, it is an explosive. It burns with an intensely hot flame, which accounts for its use in the well-known oxygen-acetylene torch used in welding or cutting metals. It is already the starting point for the synthesis of a large number of organic compounds. It can be made in large quantities, the basic materials being limestone and coke, used to make the calcium carbide.

Development Could Free U.S.A. From Need of Imports of Insecticide

Synthetic Pyrethrum Achieved

➤ SYNTHETIC pyrethrum for insect-killing sprays is the achievement of two U. S. Department of Agriculture scientists, Dr. F. B. LaForge and M. S. Schechter. It is chemically identical with the natural pyrethrum from flower-heads, except that the arrangement of atoms in the molecule has been shifted a little. This slight difference seems to be an advantage, for the synthetic product has a higher killing rate than the natural.

Several variants of the new synthetic have been prepared, and one of them has six or seven times more killing power than the natural pyrethrum. In quick knock-down effect the synthetics are at least as good as the old natural standby.

The higher fly- and mosquito-killing power of the new compounds will make it possible to prepare sprays and aerosols for space-spraying purposes without the addition of DDT. This is especially desirable where spraying has to be carried on under conditions that might result in food contamination. An aerosol spray without DDT would also have the advantage of not causing irritation to the nose and throat membranes of persons constantly exposed to it.

Synthetic pyrethrum preparations will be used primarily in sprays and aerosols where immediate results are desired. They have no residual effect; walls and other surfaces coated with them will not kill insects for months afterwards, as DDT-coated surfaces will. For residual effects, DDT will still be necessary.

Starting materials for the synthesis are pyruvic aldehyde and aceto-acetic ester. Basis of the first of these is propylene glycol, and the second is made from ordinary alcohol and acetic acid. All three of these raw materials are common industrial chemicals, obtainable in tank-car lots.

This development has been compared to the synthesis of rubber. About two years ago the structure of the toxic chemical in pyrethrum became known with certainty, after 15 years of intensive effort. It took two years more of intensive laboratory study by the chemists of the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture to reassemble the component parts in their proper order to make a chemical with insecticidal properties.

More research and development is needed before synthetic pyrethrum can be produced in quantities sufficient to appraise its usefulness fully, but chemists are confident that this discovery is the beginning of providing synthetically a chemical of wide importance in insect control.

The pyrethrum synthesis potentially frees this country from dependence on foreign sources of the natural poison. Before the war, most of the pyrethrum used in the United States came from Japan. When this source was cut off, we obtained a partial

supply from plantations in Africa. The Japanese growers have not redeveloped their old business, and the present price of natural pyrethrum is about six times as high as the pre-war figure.

As much as 20,000,000 pounds of pyrethrum flowers have been imported into the United States in one year. Imports of pyrethrum have been considerably less in recent years due to the high cost of this material as compared with that of recently developed synthetic organic insecticides on the American market.

Patents will be issued on the new synthesizing process, with rights assigned to the Department of Agriculture. Licences to produce will be granted, royalty-free, to reputable private firms desiring to manufacture the new product. Several manufacturing chemical companies have already expressed interest.

Wood Molasses for Cattle Feed

➤ Wood molasses, in a 20,000-gallon-per year volume, will be produced under a project in which the U. S. Forest Products Laboratory of Madison, Wis., is cooperating with the Tennessee Valley Authority at Wilson Dam, Ala. The raw material will be wood wastes from forestry and sawmill operations, and cull trees removed to permit better forestry growths.

Forest Products Laboratory already has a wood molasses pilot plant in operation in Wisconsin. This will be a second pilot plant, both producing a product primarily for cattle feed, to determine the best methods of extraction and the best methods of using the output for livestock feeding and other purposes.

There are plenty of young trees that should be removed in the Tennessee Valley, and plenty of logging residues and unavoidable wastes of woodworking plants. Former wastes may become an important source of primary income to farmers and foresters with the establishment of mills to use them. The Wisconsin plant has already proved that livestock molasses can be produced economically. Northern and western state agricultural experiment stations have proven its value as feed.

Wood molasses, also called wood-sugar molasses, is produced by converting the wood's cellulose and hemicellulose to sugars by treatment with hot dilute acid in a digester, or hydrolyzer. This produces a weak solution of sugar in water. Evaporation removes most of the water until the solution is of molasses consistency, half sugar and half water. For use as cattle feed, the sugar solution usually needs to be neutralized to dispose of the acid.

In the Wilson Dam plant, it is proposed to produce partially hydrolyzed products in the digester, which will give a lower yield of sugar but leave a residue that can be made into hardboard and similar materials. This promises a fuller use of the wood wastes, and a greater income. Southern hardwoods are to be used in the process.

For The Home Lab

Electro-Chemistry-IV

Electroplating

by Burton L. Hawk

➤ We will devote our concluding discussion on electro-chemistry to the important and useful process of electroplating. Chemists have brought the beauty and durability of rare and expensive metals within the reach of everyone by this simple process of coating an inexpensive metal with a thin layer of a more valuable one.

For electroplating, only a small direct current is required. Two or three dry cells should be sufficient. The object to be plated is made the cathode, and a strip of the pure metal to be deposited is made the anode. The whole is immersed in a solution of a salt of the metal to be deposited.

The metal to be plated must be thoroughly clean and free of grease. Scrape any rust or corrosion with a wire brush or steel wool. Then immerse in a boiling solution of washing soda. Finally, place in a "pickling bath" of dilute sulfuric acid.

Copper Plating

The size of the object to be plated will determine the quantity of the electrolytic bath required. The entire object should be immersed in the solution.

For every 25 cc. of water, use approximately one gram of copper sulfate. Better results are obtained if a small quantity of gelatin is added to the solution. Attach a strip of pure copper to the positive wire of your cell and the object to be plated to the negative wire. Immerse both wires in the copper sulfate solution, but do not allow them to touch.

The thickness of the plate will depend upon the strength of the current and length of time employed. You must use your own judgement to determine when a proper plating is attained.

Nickel Plating

Proceed as above, using for the electrolyte a solution of nickel ammonium sulfate—about one gram to 25 cc. of water. Add to this solution a small quantity of ammonium chloride, boric acid, and gelatin. The anode in this case will be a pure strip of nickel. Try nickel plating a copper penny.

Cobalt Plating

Although not practiced widely commercially, it is possible to plate with cobalt as well as nickel. The electrolytic solution is the same as that for nickel with cobalt chloride used in place of nickel ammonium sulfate. And, of course, cobalt metal must be the anode.

Zinc Plating

As you probably know, zinc is used to form the protective covering on galvanized iron. The zinc can be applied by spraying the molten metal on

the iron, by dipping the iron in the melted zinc, or by electroplating. For the latter method, a solution of zinc sulfate is used.

Chromium Plating

Because of its brilliant lasting luster, hardness, and resistance to corrosion, chromium is perhaps the most popular of electro-plated metals.

Articles to be plated with chromium are usually nickel plated first. The electrolyte is a solution of chromic acid (chromium trioxide), and the anode is pure chromium. Chromic acid is a powerful oxidizing agent and must be handled carefully.

Silver Plating

In plating with silver, the metal is liable to be deposited as a large spongy mass or a loose powder. In order to prevent this, potassium cyanide is added to the plating bath to cause the silver to plate out more slowly. With silver nitrate the complex silver-cyanide ion, $Ag(CN)_2$, is formed. This ion is only slightly ionized thereby reducing the concentration of silver ions in the solution; hence the metal is deposited more slowly and evenly.

To a solution of silver nitrate, add about one-half as much potassium cyanide and a small quantity of gelation or glue. Now we must pause for a word of caution. *Remember—the poisonous qualities of potassium cyanide have not been exaggerated!* You *must* be careful! Wash all utensils immediately after using. Do not allow the liquid to spill on your skin. Do not allow the cyanide to come into contact with any acid.

Proceed to electroplate as with previous metals using a small piece of pure silver as the anode.

Gold Plating

If you can afford it you can also gold plate by using a solution of gold potassium cyanide (*poisonous!*), or a solution of gold trichloride (chloroauric acid), $AuCl_3 \cdot HCl \cdot 4H_2O$.

* * *

There are many "tricks of the trade" in electroplating. Type of current, strength of current, type of bath, composition of article to be plated, concentration of bath, etc. all play an important part in the quality of the finished product. By working carefully, taking your time, and trial experimenting, you will soon be in a position to do a good job of plating on many household articles.

New Insecticides Need Thorough Testing

Possible dangers are encountered in the use of the newer insecticides, rat poisons and other pest-killing chemicals. A report to the American Chemical Society presented by Drs. James R. Wilson and Bernard E. Conley of the American Medical Association's Council on Pharmacy and Chemistry criticized entomologists and especially manufacturers of pesticides for getting these poisons into general use before their toxicity to human beings, especially as food contaminants, has been thoroughly investigated. He announced the pending organization of a joint Committee on Pesticides, to go into this question.

Save Nylons—and Lives—
By Fighting Air Pollution

Solved—Not Dissolved

➤ "If people won't fight air pollution to save lives, maybe they will to save stockings." This is the reaction of one chemist to the Case of the Running Nylons, reported from Jacksonville, Fla.

Sulfur compounds clinging to particles in the air are the best bet for "who done it" in the case of the nylons. But scientists point out that lives as well as stockings can be saved by cleaning up the air over American cities. A more tragic case of air pollution was the loss of 20 lives in Donora, Pa., last fall from a death-dealing smog. Scientists are still studying the air over Donora to get full facts on the chemistry of the disaster there.

More facts are known about the nylons, because that same thing has happened elsewhere. When it struck in 1940, scientists at the National Bureau of Standards solved the case. Sulfur dioxide on particles in the air from chimneys in a small area were forming sulfuric acid. The particles were found on the running hosiery—both nylons and silk. The acid weakened a thread, causing a run—or in some cases many threads on the same stocking.

The nylon or silk does not vanish into thin air or form a gas which makes them disappear. They simply get runs.

The du Pont Company, queried about chemicals that could damage nylon, states that the most common solvents for nylon at ordinary temperatures are formic acid, phenol, meta-cresol, cresylic acid and xylenol. Strong oxidizing agents and mineral acids such as hydrochloric and sulfuric acids, they point out, cause degradation of nylon yarn, and concentrated nitric acid causes rapid disintegration.

"Since the war", a representative of of the company stated, "we have furnished yarn for about one hundred million dozen pairs of nylon hosiery, and since situations similar to the one in Jacksonville have been extremely rare, it is apparent that these chemicals are not ordinarily in the atmosphere to the extent that nylon stockings would be damaged. We have previously investigated the few similar occurrences of the failure of nylon and silk stockings.

"The findings in our previous investigations were that the small holes which started the runs in the stockings were caused by small particles of soot settling on the stockings. Black smudge spots were found at the breaks in the threads. This invariably occurred under atmospheric conditions of very high humidity, such as fog and dew.

"The black smudges on the stockings were so minute that it would have been very difficult to have determined the exact nature of the

damaging material, but it was determined that the material was acidic in nature."

Sulfur compounds in the air are an old enemy of clothes. Several years ago in New England, all types of cotton goods, but particularly men's shirts, were found to be breaking up under certain apparently normal conditions. Investigation revealed that sulfuric acid was being formed from sulfur-containing particles in the air.

Scientific tests here indicate that the runs will strike old or new stockings of either nylon or silk. The sheerest hose pulled tightly over the leg will, of course, be most likely to have the threads wear through.

But the best way to prevent run epidemics is simply to keep the air clean. In addition to saving stockings, it can save health and lives.

Germanium Replaces Tubes

➤ A TINY BIT of germanium metal may soon be used instead of a vacuum tube in radio receivers and other instruments where simple amplifying is required. In telephony and electronics in general the germanium device has great possibilities. The device which utilizes this semi-conductor metal is called a transistor. Basic work on the transistor was carried on at the Bell Telephone Laboratories.

These transistors, are about the size of medicine capsules but can perform most of the key jobs now done by vacuum tubes. They operate entirely without vacuum, they have no filament to cause warm-up delay, and they are smaller and lighter than commercially available vacuum tubes.

Greater Protection Against Sun

➤ GOOD NEWS for sunburn victims comes with the announcement of two compounds that give five to eight times more protection against sunburn than any now in use.

The compounds are ethyl-p-diethylaminobenzoate and methyl-p-dimethylamino-benzoate. Their protective action against sunburn was reported to the American Pharmaceutical Association by Drs. W. D. Kumler and T. C. Daniels of the University of California College of Pharmacy.

These chemicals have proved less likely to change or deteriorate in the presence of sunlight, air and moisture than many now used. They can be applied in lotions, ointments or solutions. The compounds are not harmful or irritating to the skin and permit good tanning.

Laboratory experiments and observations of persons who have used these chemicals show thev give more protection than other compounds when the sunlight is in the "sunburn" region of the light spectrum. Good tanning is possible because they do not absorb sunlight beyond the wavelengths where rays don't burn.

California's Big Atom Smashers Make Nuclear Study Progress

Mesons Created From X-rays

➤ Creation of the mysterious cosmic ray particles called mesons from the world's most powerful X-ray beam was reported to the American Physical Society at its meeting in Berkeley, California, by Dr. Edwin McMillan of the University of California Radiation Laboratory.

Dr. McMillan said that the cosmic ray particles had been made in the laboratory with the 300,000,000 electron-volt synchrotron.

Production of mesons by radiation in the synchrotron is believed to be the first direct evidence that these potent particles can be made from electromagnetic radiation. Light, heat, electricity and radio waves are forms of electromagnetic radiation. Another is the X-ray beam of the synchrotron.

The synchrotron, invented by Dr. McMillan, uses electrons, negatively charged electric particles, to bombard a heavy metal target. This creates the powerful, highly-penetrating X-ray beam.

First man-made mesons were created last year in the California laboratories with the giant 184-inch cyclotron, another type of atom smasher. In the cyclotron, high-speed hearts of helium atoms (alpha particles) were used to break the cosmic ray monopoly of meson making.

Nuclear physicists believe that the meson holds many of the secrets of the still little-known heart or nucleus of the atom. Producing mesons in the laboratory may solve some of the potent particle's mysteries.

Now, atomic scientists have a new type of factory for producing mesons for study and experiment.

The Synchrotron

The machine accelerates electrons to 300,000,000 electron volts, and these particles, upon impact with a heavy metal target, liberate X-rays of the same energy. The fine, highly penetrating X-ray beam, the most powerful in the world, is used for bombarding atoms.

The new synchrotron is one of four atom-smashers operated by the University of California in its research program for the Atomic Energy Commission. It was described to the meeting of the American Physical Society by its inventor.

The atom-smasher is three times as powerful as its cousin, the betatron, another type of electron accelerator; and several times as powerful as three smaller operating synchrotrons, two in England and one in the United States, which have a capacity of 70,000,000 electron volts or less.

The synchrotron is a finer atom-smashing tool than the giant cyclotrons. The fine radiations it produces

are expected to duplicate many of the phenomena observed in bombardments with the heavy nuclear projectiles—protons, deuterons and alpha particles—of the cyclotrons. In addition, it is expected to furnish mesons, the ephemeral particles found in cosmic rays which are intimately associated with the force which holds the nucleus together.

The synchrotron may be able to produce cosmic ray showers similar to those found in nature, and may be the means for determining if neutrons and protons are divisible.

Vibrations caused as 160 kilowatts is thrown into and drawn out of the 135-ton electro-magnet cause parts of the machine literally to shake. The concrete foundation vibrates, in spite of the rubber pads on which the machine is mounted, and the synchrotron almost appears to be dancing a jig.

A loud noise accompanies operation. As the machine is turned on, a low thumping is heard, and this builds up to a loud, regularly spaced hammering as the magnet reaches full power, a noise akin to a high-powered diesel engine. Observers have remarked that this is an atom-smasher in which the atoms can be heard to crack.

The synchrotron is based upon the concept of phase stability which during the postwar period has revolutionized atom-smashing and upon which are based the billion-volt machines now on the drawing boards.

This concept of phase stability, originated independently by Dr. McMillan and the Russian scientist Veksler, in 1945, circumvents the Einstein relativity principle which had apparently put a ceiling on the energies to which particles could be accelerated.

Relativity states that as a particle gains energy it gains mass; and while the particle, when it becomes heavier, can still be accelerated, this can be done only at a slower rate. In prewar atom-smashers this meant that as projectiles reached higher energy they would lag and fall out of step with regularly timed pushes.

The synchrotron gets around this in a unique way. As the electrons reach higher and higher energy, the power of the field of the magnet is increased proportionately. The result is that the laggard electrons are jerked up to the acceleration point in time to be propelled to higher energy.

Electrons are accelerated in a doughnut-shaped quartz chamber, two meters in diameter, which is placed between the ring-shaped poles of the electro-magnet. The quartz chamber is silver plated, except for a short section, a gap at which point the particles are propelled.

When electrons are injected into the chamber, they are first hustled around the orbit by the sheer force of the magnet acting on the particles. Up to 2,000,000 electron volts, the machine thus operates as a betatron.

At 2,000,000 electron volts, high frequency power is poured on the silver plating of the chamber, making it a resonant cavity. Operation is timed so that as the electrons reach the gap in the cavity, the far side

of the gap is positively charged. This attracts the electrons violently across the gap, speeding them up. By the time the electrons go around the circle again, the current has gone through a complete cycle, and the electrons receive another push. The oscillator providing the accelerating current is capable of reversing the alternating power 48,000,000 times a second.

The magnet guides the particles around the orbit.

The synchrotron goes through a full operation six times each second. For each operation, lasting for a period of one-thirtieth of a second, a "flight" of electrons is accelerated to full energy. Each "flight" tours the chamber 480,000 times before it reaches 300,000,000 electron volts. By the time an electron reaches that energy, it weighs 600 times as much as it did at rest.

When a flight of electrons reaches peak energy, the oscillator is turned off. The electrons, no longer receiving accelerating impulses, spiral inward, strike a heavy metal target, and liberate X-rays.

Power for the synchrotron magnet is stored in the largest condenser bank in the world, which acts like a storage tank. The "tank," consisting of 3,328 condensers and storing 100,000 joules, is kept full by an ordinary power line.

During the one thirtieth second operations, this tremendous power is switched into the magnet and back into storage again by four ignitrons. The power loss is small, and this makes for economy.

The magnet has a field strength of 10,000 gauss, stands 98 inches high, 194 inches long, and 92 inches in breadth.

Dr. McMillan's chief associate in construction of the machine was Marvin Martin, engineer in the Radiation Laboratory. They were assisted primarily by Drs. Robert Serber, Wilson Powell, A. C. Helmholz and by George Farley and Leslie Cook, all of the Radiation Laboratory scientific staff. Walter Gibbins was in charge of the work crew.

The Cyclotron

The world's most powerful beam of protons has been fired by California University's cyclotron. The protons pack 350,000,000 electron volts of energy.

The 4,000-ton cyclotron has been the world's most powerful since it went into operation in 1946. But heretofore it accelerated only deuterons, the nuclei of heavy hydrogen atoms, and alpha particles, the nuclei of helium atoms. Protons are the nuclei of ordinary hydrogen.

New equipment installed in the machine in December makes it possible now for Berkeley scientists to switch at will from one to another of the three types of atomic bullets. Operation of the machine is a part of the University's research program for the Atomic Energy Commission.

This was reported to the meeting of the American Physical Society by Dr. Kenneth MacKenzie, who collaborated with William Brobeck, assistant director of the Radiation Laboratory,

in designing new equipment for the machine.

Dr. Robert Thornton, physicist in charge of the cyclotron, said that neutrons produced in bombardments by the protons range in energy up to 350,000,000 electron volts. The previous top energy for neutrons was the 100,000,000-electron-volt-beam produced by deuteron bombardments with the same cyclotron.

Research with the protons will also enable scientists to penetrate farther into the atomic nucleus and to learn more about its structure.

Acceleration of protons was made possible by changes in the oscillator, which supplies the radio frequency power to drive the atomic bullets around the cyclotron chamber. The change was necessary partially because the proton, only one half the weight of the deuteron, travels faster.

With protons, the oscillator starts out by giving the particles a push 50,000,000 times a second. By the time the bullets reach their top energy they have become somewhat heavier and begin to lag; to compensate for the lagging, the pushes at this point come 30,000,000 times a second.

For deuterons, the accelerations at the beginning are 25,000,000 per second and 17,000,000 a second when they reach their top energy.

At 350,000,000 electron volts, the protons have a velocity of 125,000 miles per second (two thirds the velocity of light). About 1,000,000,000,000,000 emerge from the atom-smasher each second.

The new oscillator is capable of putting out 100 kilowatts of high frequency power, comparable to a high-powered radio station.

Dr. Thornton said the 10-foot wall of concrete surrounding the cyclotron is sufficient protection for personnel against the high energy radiations.

Clicking Detector for Lead in Air

➤ A DETECTOR for poisonous lead in the air that clicks madly, in a warning similar to that of a Geiger counter affected by radioactivity, was announced to the Optical society of America by Henry Aughey, of the DuPont Experimental Station, Wilmington, Del., and O. G. Koppius of the Philips Laboratories.

Atmospheric contamination by lead is an acute problem in the chemical industry. The new instrument can be carried about to test air wherever the danger of this accumulative poison exists. It is extremely sensitive and gives an approximate assay of the air in addition to detecting relatively high concentrations of lead, whether combined chemically or in its form as an element.

Suspected air is drawn through a spark discharge, the light from which is caught and split up by a quartz spectroscope. The tell-tale lines of lead are measured in two ways: Photographically or by substituting a photoelectric Geiger counter for the photographic plate. As little as one part in 20,000,000 of lead can be made to register as warning counter clicks.

Atomic Furnace Factory To be Built in West

AEC Atomic Power Program

➤ An atomic furnace factory where machines for releasing atomic energy will be manufactured and tested is planned for construction at Pocatello, Idaho. This program for the development of nuclear reactors, was unveiled by Dr. Robert F. Bacher, scientist-commissioner of the U. S. Atomic Energy Commission to the American Academy of Arts and Sciences meeting in Boston. It calls for operation, construction or investigation of nearly a dozen different kinds of atomic machines.

Three kinds of nuclear reactors were built during the war: chain-reacting piles at Chicago and Oak Ridge, Tenn.; and the big reactors at Hanford, Wash., for making the synthetic atom bomb element, plutonium. A high-energy atomic furnace has been put into operation at Los Alamos, N. Mex., since the war, and a more conventional chain-reacting pile is nearing completion at Brookhaven National Laboratory on Long Island.

Four new kinds of reactors will be built in the near future. They are:

1. Materials testing reactor for testing materials for use in atomic machines. This high-energy, small-space reactor has been under design for two years at Oak Ridge National Laboratory.

2. Naval reactor to be constructed by Westinghouse will be a land-based prototype for a shipboard atomic power plant. Plans are being developed at Argonne National Laboratory near Chicago, and construction will be started in about a year.

3. High-energy experimental breeder or fast reactor being designed at the Argonne Laboratory. It will operate with high energy atomic bullets, or neutrons, like the present Los Alamos pile, but will be more powerful and use uranium 235 instead of plutonium for fuel.

4. An "in-between" reactor operating with neutrons at intermediate energies, between the slow neutrons of the wartime piles and the high-energy pile at Los Alamos. The intermediate reactor will be built at the Knolls Atomic Power Laboratory operated by General Electric at Schenectady, N.Y.

Both the materials testing reactor and the land-based Navy plant will be built at the new atomic power field station.

He described the new station as a "field facility" of the Argonne Laboratory, major center of the Commission's nuclear reactor work.

When work is begun, the new site will come under the secrecy regulations which govern the Hanford plant in Washington state. In addition to the two reactors scheduled for construction at Pocatello, others will probably be manufactured at this atomic furnace factory.

In addition to the four new types of reactors now moving from the drawing board to construction stage, four other new kinds of atomic energy machines are under study.

1. Still in the study stage, but getting lots of attention, is nuclear reactor for aircraft, being investigated in a project called NEPA (nuclear energy for propulsion of aircraft). A survey of this field by the Massachusetts Institute of Technology is now being studied by the Commission.

2. A power plant using natural uranium for fuel. The Hanford plutonium-making reactors use natural uranium, but harnessing this fuel for power production is a job for the future.

3. Homogeneous reactor in which the fuel and materials for cooling, moderating and reflecting would all be mixed together instead of having fuel embedded in the other materials.

4. A simple, low-cost reactor for scientific research and training of new technical people in atomic energy.

End products of this program of atomic machine research and construction may be economically useful electrical power from atomic energy.

Tantalum Metal for Nerve Surgery

➤ TUBES OF thin tantalum metal foil, for use in nerve surgery, have been patented by Dr. Paul A. Weiss, the University of Chicago neurologist who devised the method. Rights in U.S. patent 2,451,703 are assigned to the government.

Tantalum, a grayish-white metal little known until recently, has become a preferred material in many surgical uses because it does not corrode in the presence of any of the body fluids and has no irritating action on the tissues. For nerve surgery it must be used exceedingly thin; five ten-thousandths of an inch has been found the best thickness. It must also be heat-treated to increase its resilience.

To make his nerve-mending tubes, Dr. Weiss wraps a piece of tantalum foil around a quartz tube of the desired diameter, binding it on with fine steel wire. He runs a steel rod through the quartz tube, for heat-conducting purposes, and puts the whole into an electric furnace for a minute or so at 800 degrees Centigrade. After cooling, the tube is stripped off and trimmed ready for use.

Dr. Weiss has also used nylon and short pieces of artery in his nerve-mending procedure. These materials, however, are not considered in the present patent.

Formalin, now inexpensive and easily obtainable, is recommended as a disinfectant for shoes.

Starfish meal for chickens, made by drying and grinding whole starfish, contains about 30% protein, over 17% calcium, and 0.35% phosphorus.

Chain-Reacting Piles at Nine Locations in Four Nations

World Has 15 Atomic Reactors

➤ THERE are 15 atomic piles, or "furnaces," in operation or about to operate in nine locations in four countries.

So far as known, these chain reactors operating on uranium exist only in the United States, Canada, Britain and France.

It all began Dec. 2, 1942, when Stagg Field of the University of Chicago saw the start of the atomic race which will mean either the winning of new power or the loss of civilization. That was the day that the first pile, built under the stands at that athletic field, was gingerly and apprehensively brought to the point where neutrons from the fissioning of uranium 235 became sufficient to sustain and repeat the action. Heat and powerful radiation were let loose, converted from the very mass or substance of the uranium metal in the pile.

This was the most essential step toward the atomic bomb which was first exploded in 1945.

Now the chain reactor has progressed from a scientific experiment to a tool that has the following uses:

1. Manufacture of plutonium, element 94, which is the ingredient of modern atomic bombs. It was authoritatively learned from the Atomic Energy Commission that three large reactors at Hanford, Wash., are at work. Their purpose is to convert non-fissionable uranium 238 into plutonium, the synthetic element that can be split asunder by neutron bombardment to release energy.

2. Production of radioactive varieties (isotopes) of chemical elements for use in treatment of disease and as "tracers" for unraveling what happens in living things and in industrial processes. The pile at Oak Ridge, Tenn., is used for this purpose.

3. Production of radiation and particles for the further investigation of the fundamental properties of matter and energy. The two reactors at Argonne National Laboratory near Chicago, direct descendants of the Stagg Field original pile, are being used primarily for this purpose.

4. Improvement of atomic weapon design. Two "furnaces" at Los Alamos, N. Mex., are devoted to this task. One of them is a fast reactor without the heavy water or graphite moderators, used in other piles to slow down or regulate the reaction. This fast reactor is essentially a controlled atomic bomb, caused to act slowly without explosion.

5. Production of atomic power. Despite the fact that atomic energy release is six years old, no atomic reactor is yet operating solely for the production of power. At Knolls Laboratory, near Schenectady, N.Y., the first experimental power pile is being built.

Two reactors are building in the United States, the power pile at Knolls and a research reactor for the Brookhaven National Laboratory on Long Island, N.Y., which should start operation in 1949.

Britain has two piles at Harwell, one recently completed and another that has been going for over a year. Canada has a small experimental unit and a larger research pile in operation at Chalk River, Ont.

France has one pile at Chatillon which started operation in December.

So far as is known, the U.S.S.R. has not yet operated a chain reactor, although it would not be surprising if one has been achieved by Russian scientists.

The atomic reactor score is: U.S.A. eight operating, two under construction; England, two operating; Canada, two operating; France, one operating; rest of the world, none.

New Uranium Mineral From Congo

➤ A NEW RADIOACTIVE mineral containing the atomic bomb element, uranium, has been discovered in Africa and identified in America.

The newly-discovered mineral was found in the Belgian Congo. J. F. Vaes, of Union Miniere, Jadotville, Belgian Congo, sent samples to Dr. Paul F. Kerr, Columbia University geologist, in New York City.

Laboratory tests by Dr. Kerr showed that the material is a previously unknown uranium mineral. It has been named "sengierite," in honor of Edgard Sengier, who directed wartime mineral production in the Belgian Congo.

Sengierite is found in small green crystals which cling to a chlorite-talc rock found in mines in the Belgian Congo. It is similar to the American uranium mineral, carnotite, except that sengierite is a copper uranium mineral, while carnotite is a potassium uranium material.

Protection Against Lead Poisoning

➤ A NEW AID to protection against lead poisoning was announced by Dr. Lall G. Montgomery and Everett Johnson of Muncie, Inds. at a recent meeting of the American Society of Clinical Pathologists.

People who have been exposed to lead, as in certain industries, excrete through their kidneys more than the normal amount of pigments called porphyrins, the Muncie scientists found.

Among college students, student nurses and employees of an industrial plant in which there was no measurable lead exposure, less than 2% excreted more than normal amounts of these pigments. Among employees of industries in which variable amounts of exposure to lead were possible, 34% excreted more than the normal amount of porphyrins. Several patients with lead poisoning all excreted increased amounts of porphyrins.

The porphyrin excretion, by giving an index of exposure to lead, might help prevent lead poisoning by showing which employees were in danger and needed to change their work and also which spots in industries needed extra protective measures to reduce exposure to lead.

Chemical Test to Speed Anti-Cold Drugs, Vaccine

New Light on the Common Cold

by Jane Stafford

➤ A DRUG to cure the common cold or a vaccine to prevent it may come faster, thanks to a chemical test developed by two U. S. Public Health Service scientists, Drs. Leon T. Atlas and George A. Hottle of the National Institutes of Health.

The test detects the presence of the common cold virus and tells how much of it is present in a given sample of material. When certain chemicals are added to virus-containing material a pink to brown color develops. A very light pink color means a little virus. A very deep brown means lots of virus. To determine the exact amounts scientists measure the intensity of the color with a spectrophotometer. The chemicals used are tryptophane, an amino acid, and perchloric acid. Details were reported in *Science*.

The speed-up on work toward a cure or preventive for the common cold comes from the fact that with this test scientists can do as many of certain procedures in one routine day as have so far taken two years.

First steps in trying to make a vaccine against a disease are to isolate the germs causing it and grow them outside the body in large quantities. In the case of colds, this can be done by washing out the nose of the cold victim with milk and growing this material on fertile hen's eggs.

But the only way scientists have had so far of knowing whether the cold virus was present in the material from the victim's nose, or had grown on the eggs, was to spray some of it in a healthy person's nose and wait to see whether he got a cold.

And if they wanted to know how much virus is needed to cause a cold, essential for development of a vaccine, they had to spray different dilutions of virus-containing material in different noses and again wait to see whether colds developed.

These tedious, time-consuming procedures will be eliminated by the new test. Human volunteers will still be needed for some phases of cold research. Examples Dr. Atlas gave are recognizing the various agents which may cause colds, studying susceptibility to fresh colds, the length of time a cold lasts, and the effect of drugs, climate and various other factors on attacks of colds and their course.

Tests of aureomycin, new mold remedy, as a cold cure and of diluted virus as a vaccine are planned.

The chemical test has been successful in detecting and measuring a virus called MR 1. Decoded, this means Minor Respiratory 1. It is the code name given the virus which Dr. Atlas and Dr. Norman Topping of the National Institutes of Health announced just a year ago. Dr. Atlas got it from the nose of a scientist to whom he was giving a physical examination preliminary to a U.S. Public Health Service fellowship.

With the aid of 500 volunteers among inmates at Lorton Reformatory, District of Columbia penal institution, Drs. Atlas and Topping made sure that this virus definitely causes colds. Because it may not be the only virus that causes colds, or what the scientists term minor respiratory diseases, they have given it the number, "1," to identify it.

Dr. Atlas hopes that the new test will enable him and fellow scientists to isolate and study other viruses that may be causing the minor respiratory diseases now lumped under the name of a cold.

The test might be made specific for each virus, not only of colds but of other diseases such as infantile paralysis, measles and so on. If so, it would speed new knowledge for fighting these diseases. Its potential usefulness in this way comes from the fact that it is based on a chemical difference between infected and non-infected fertile hen's eggs, probably on the chemical composition of viruses in general, not a specific one.

Symptoms of MR 1.

➤ YOUR NOSE is stuffy. There is a little irritation at the back of your throat and nose. You feel tired. You sneeze a bit and your nose is a little "runny." Then you get a real burr or irritated feeling in your throat. Your eyes are a little sore and burn and water a little. A trickle in the back of your throat makes you keep "hawking" to clear it. After a day or two of this you are hoarse. In another day or two you may have a slight fever and a sore throat. You ache a little and have a feeling of congestion in your chest. You don't cough much, except for the early morning "hawking." You have headache over your eyes.

If you have those symptoms in that order, the chances are you have caught MR 1. You call it a cold, and so it is. MR 1 is the scientific code name for the virus that causes the cold with those symptoms. The letters MR stand for minor respiratory, the scientists' term for the infections the layman calls a cold.

In humans this virus always causes exactly the same kind of a cold, with the symptoms described. This has amazed the scientists studying it. They thought the symptoms of a cold would vary according to the person who got it.

Climate apparently has no effect on this cold. Volunteers got exactly the same kind of cold, winter or summer, in rainy weather and regardless of the barometer reading. They got it whenever the virus was sprayed or dropped into their noses.

Eating onions or garlic and various other popular measures for warding off colds had no effect. The volunteers, inmates of Lorton Reformatory, the District of Columbia penal institution, tried a lot of them, on their own, the day before they were to have the virus put up their noses. But their favorite anti-cold remedies failed.

Dust Germier Than Sneeze

➤ THE AIR gets more germs in it from dust off clothing and skin than from a good hearty sneeze.

Each person in the course of his normal activities looses a barrage of about one million bacteria-carrying dust particles per day.

These observations bearing on the spread of colds and other diseases

through germs in the air were made by two Scottish bacteriologists, J. P. Duguid and A. T. Wallace, of the University of Edinburgh. American disease fighters read details of the Scottish experiments in the *Lancet*, medical journal published in London.

Many of the dust particles from skin and clothing may remain in the air for over half an hour, the Scottish scientists found. These dust particles, they think, are at least as good as sneeze-produced droplet nuclei in supplying the physical means for air-borne spread of disease. The droplet nuclei are tiny solid residues evaporated from small droplets. The nuclei stay in the air for several minutes or hours after droplets are sprayed or sneezed into the air. The larger droplets fall out of the air within one or two seconds.

Part of the Scottish experiments were made with two persons known to be harboring Staphylococcus aureus germs in their noses. Some of these staph. germs cause food poisoning, some cause boils, some cause what the layman calls blood poisoning. In the experiments the staph. carriers were in a small, closed room that was carefully guarded against any germs or bacteria except those of the carriers.

They went through the motions of certain laboratory procedures, to see how many dust particles would be let loose from their skin and clothing in the course of normal activity. To get the effect of vigorous activity, they "marked time" at walking pace continuously for 10 minutes, swinging the arms and raising the feet. And they tickled their noses with cotton wool swabs to bring on vigorous sneezes in quick succesion.

Samples of the air after several tests with activity and sneezing were examined. From 840 cubic feet of air contaminated by 42 vigorous sneezes only 16 droplet nuclei carrying staph. germs were recovered. But 124 dust particles carrying these germs were recovered from 150 cubic feet of air contaminated by vigorous bodily activity for 150 minutes.

Surgeons will be interested in the finding that the loose cotton gown usually worn in operating rooms was not able to prevent bacterial contamination of the air from the skin and clothing.

"Our present findings," the scientists state, "show that a large amount of dust-borne bacterial contamination of the air may be caused by ordinary body movements, and that some of the infected dust particles may remain air-borne for a time more than sufficient to allow their drifting to the operating table from all parts of the theatre (operating room) and from rooms and corridors adjoining."

Instead of the usual operating gown, the scientists recommend a modified "boiler suit," consisting of a zipper-closed one-piece garment of heavy close-woven cotton twill with elastic bands over the cuffs of the long sleeves and heavy canvas socks sewed to the bottom of the trouser legs and worn over the shoes. This, they found, allowed only four per cent of the air contamination in vigorous activity given in comparable experiments without gowning. They plan to wear this boiler-suit themselves in further studies of air contamination, to rule out the germs they themselves may be introducing into samples they test.

Scientist Who Discovered Streptomycin Finds New and Better Drug From Soil

Neomycin—New Antibiotic for TB

➤ WITH THE HOPE of completing the medical conquest of tuberculosis, a new drug from the soil better than streptomycin has been discovered by Dr. Selman A. Waksman, the Rutgers University microbiologist who has already given the world the best treatment of the white plague. Christened neomycin, the new antibiotic comes from the same general kind of microscopic organism that produces streptomycin.

Neomycin has the great advantage of being active against strains of human tuberculosis germs that cannot be stopped by streptomycin. Experiments outside the living body, with limited amounts of the new wonder drug, demonstrate this superiority and show that it lacks troublesome toxicity that has tended to limit treatment of some tuberculosis cases.

Tests first in animals and then in human cases will be made when the Rutgers laboratory and cooperating manufacturers produce enough neomycin. So new is the drug that not all the inevitable difficulties in manufacture have been solved. But the same apparatus and general methods used in streptomycin production can be used for neomycin.

When given to mice by mouth, neomycin was effective in combatting germ infections. For this reason, scientists hope that tuberculosis will eventually be treated by a drug that can be swallowed, saving patients the bother of injections now necessary with streptomycin.

A large variety of bacteria other than those that cause human and animal tuberculosis are subdued by neomycin, and the new drug gives promise of fighting infections that have built up resistance to streptomycin.

Details of neomycin's discovery were published by Dr. Waksman jointly with Hubert A. Lechevalier, a graduate student from Canada.

The new antibiotic is produced by an organism known as Streptomyces fradiae, whereas streptomycin is produced by a very closely related strain of these actinomycetes, known as Streptomyces griseus. Strangely, the two substances are different both chemically and in the way they act on bacteria.

Striking reports of effectiveness of streptomycin in treating tuberculosis are being received by Dr. Waksman from all parts of the world and it is being produced abroad as well as by eight companies in this country. Streptomycin is now only five years old.

Streptomycin does produce some nerve symptoms when it is administered for a prolonged time and this limitation, as well as the resistance that develops in some cases, will cause doctors to welcome neomycin when it proves itself and is produced in sufficient quantity. The neurotoxic effect is upon the eighth nerve, which controls body balance, and causes dizziness and inability to walk a straight line without wobbling.

Close to Absolute Zero Things Act Strangely But Usefully

Temperatures Far Below Zero

One of the Science Service "Adventures in Science" radio programs over the Columbia Broadcasting System.

DAVIS—This is Watson Davis, speaking from Washington. We are going to explore temperatures far below zero. You may think that the coldest place on earth is the Arctic or the Antarctic or is upon some high mountain peak. Actually, the sub-zero temperatures which nature produces even in the most frigid places are hot in comparison to the extremely low temperatures that are produced in scientific laboratories. It is not just scientific curiosity or a desire to make records that causes scientists to work at the extremely low temperature at which even the air we breathe becomes solid. There are real practical advantages and applications of low temperature which are used today by industry and the military services. Our Adventures in Science guests today are physicists of the United States Navy. They are Dr. Elliott Montroll, head of the Physics Branch of the Office of Naval Research, and Mr. Lawson McKenzie, also a physicist in the Office of Naval Research. First of all, Dr. Montroll, just how low is a low temperature?

MONTROLL—When it gets to be 20 to 30 degrees below zero as it sometimes does at White Bear Lake, Minnesota, in the winter, that is a rather low temperature physiologically speaking, but I want to tell you about laboratory weather that exists only within our apparatus to which White Bear seems like British Guiana.

DAVIS—Well, just how cold is the coldest possible?

MONTROLL—I am afraid that the figures do not mean very much. As we all know, all matter consists of atoms and molecules. These atoms and molecules are constantly in motion. For example, at room temperature the molecules of the air move at 1100 miles per hour. The speed of the molecules at the temperature at which alcohol in your car radiator freezes at 166 degrees below zero is 700 miles per hour. Finally, at very, very low temperatures the molecules of the air actually become so sluggish that they have practically no motion at all. This state is reached at temperatures many degrees lower than room temperature and, in fact, the temperature at which all molecules are at rest is known as absolute zero. This is the lowest imaginable temperature. It is a condition which things have when they are absolutely free of thermal disturbance. Actually, it is a completely unattainable situation, like so many things in life as well as science, but we can get very close to it.

DAVIS—Just what would that be on the kind of thermometer that we read every morning to see how cold it is?

MONTROLL—459.72 degrees below zero, but the scientists use a better temperature scale which starts at this absolute zero. It is called the absolute temperature scale.

DAVIS—I am not sure that means too much. Suppose we approach absolute zero by easy stages, Dr. Montroll.

MONTROLL—That is a good idea, Mr. Davis, because that is really the way the early scientists did it. You see, water freezes at 32 degrees Fahrenheit or 273 degrees absolute. Everyone is familiar with solid water. Now when it comes to making air liquid by refrigeration or better yet liquefying the gases hydrogen and helium, that is something else again. Air is made liquid at 80 degrees above absolute zero. Hydrogen is liquefied at about 15 degrees above absolute zero, and helium gas is made liquid only about 4 degrees above absolute zero. There are perhaps 25 places in the world which can get down to those low temperatures and yet that is the range in which all of the most interesting low temperature investigations from a research standpoint are being done. Before the war there were less than a dozen places where this could be done.

DAVIS—I would like to ask Mr. McKenzie just what sort of things happen at these very low temperatures of a few degrees above absolute zero. I understand very strange things do happen.

MCKENZIE—Yes, Mr. Davis, electricity flows almost without hindrance in some metals. Liquid helium has very strange actions. It seems to be able to flow up hill. There are also strange magnetic and other effects.

DAVIS—Well, Mr. McKenzie, that sounds most amazing. Tell us about it.

MCKENZIE—Liquid helium boils at 4.22 degrees absolute. That is 456 degrees below zero Fahrenheit. This was the last gas to be liquefied by man, and it was first done in 1908 at Leyden University in Holland by Kamerlingh Onnes, the famous Dutch pioneer in low temperature research. The most amazing thing about this liquid is that it remains a liquid as we approach absolute zero.

DAVIS—Well, let's get this straight, Mr. McKenzie. We really cannot ever get down to zero temperature, can we, and I understand that all we can do is approach zero, getting closer and closer to it.

MCKENZIE—That is right. It is one of those theoretically unattainable things in science. You see, Mr. Davis, all other liquids turn to solids on being cooled enough as Dr. Montroll explained. Your point is in accord with the so-called third law of thermodynamics. This law tells us that everything settles down into a state of good order where everything is as quiet as possible, as far as molecular motion is concerned. However, the amazing liquid, helium, can not solidify because it does not condense in the usual manner except under extremely high pressures. Physicists have been baffled to explain what happens. The latest ideas which fit observations on liquid helium merge with some of the latest work in atomic physics.

DAVIS—What this liquid helium can do is rather interesting, isn't it?

MCKENZIE—Yes, at two degrees absolute temperature, helium conducts heat a thousand fold better than copper. This is the highest thermal conductivity known to man. Also, liquid helium shows no viscosity. That is just a way of saying that it flows without drag. It is, therefore, called a super-

fluid. The liquid at these low temperatures becomes like a thing alive. It will creep up the sides of the vessel containing it, seeking a region where the temperature is warmer. These properties actually require a new approach to understand just what happens. Dr. Montroll will remember that there is a theory which led to some interesting predictions which proved to be true.

Davis—Well, Dr. Montroll, what about these predictions?

Montroll—To try to understand how this amazing liquid, helium, acts, Prof. Laizlo Tisza now of the Massachusetts Institute of Technology conceived that energy could be passed through the liquid by means of a temperature wave. This is in contrast to the diffusion process we usually refer to. Dr. Tisza urged his colleagues to look for this new effect. This was before the war and unfortunately in this country during the war most research scientists were called into more urgent programs.

Davis—Dr. Montroll, you say in this country. Was research not stopped in other countries too?

Montroll—Yes, of course, it was to a considerable extent in fields that did not seem to be immediately practical. But it is an interesting fact that in Russia many scientific laboratories continued their work throughout the war years. Apparently, the Soviet regime felt that it was worth continuing the pursuit of pure research. During the war Prof. Tisza's prediction about energy being transported through liquid helium by means of a temperature wave was verified experimentally by the Russian scientist Peshkov.

Davis—Perhaps you had better tell us what the discovery amounted to.

Montroll—Well, you know, Mr. Davis, that sound was used during the war to detect submarines. As a device on the navy ships it sent out through the water a bundle of energy in the form of very high frequency sound waves. This energy bounces off the target, and the return echo is received, amplified and presented on a screen so that it can be seen. The energy involved in this sound detection device is propagated as pressure waves. Now the new kind of wave effect predicted by a Hungarian scientist in France and discovered by a Russian is a temperature wave called second sound. The interpretation of the mechanism propagating this temperature is not clearly understood, but research supported by the Office of Naval Research is getting at the problem.

Davis—If the scientist cannot quite understand, perhaps we had better not try to do so either.

Montroll—I am very much interested in the idea of electricity flowing without hindrance through any substance. This superconductivity sounds as though it might be put to work because if we can reduce resistance, we can save a lot of electrical power, can't we, Mr. McKenzie?

McKenzie—Actually, it has been put to work in a limited way. During the war you will remember there was a device that allowed our soldiers to see in the dark by detecting the heat waves given off by men and objects even on the darkest of nights. This device is based upon what is called a

bolometer, a heat measurer. It is the heart of the apparatus. One such substance which is sensitive to infra-red or heat signals is a metal in the superconducting state. The superconductivity of the metal is destroyed by impinging heat radiation. This permits use of superconductivity as a heat detector and in fact, it is one of the most sensitive heat detecting elements known. There was developed at the John Hopkins University during the war under government contracts a detecting device built around a superconducting responsive element for use in detecting the heat waves given off by hot motor exhausts, smoke stacks of warships and factories. It is interesting also to state that recently these same detectors have been found to be responsive to radio signals. Actually, we know very little about superconductors and the only opportunity to explore the behavior of these particular substances is when they are made extremely cold.

Davis—Since a good many metals and their alloys do show exceedingly small electrical resistance when they are a few degrees above absolute zero, is there any chance this could actually be applied to the problem of transmitting electrical current?

McKenzie—I think that is a little optimistic, but at the Ohio State University a coil of an electromagnet is cooled with liquid nitrogen to achieve just this. I should like to tell you about a famous experiment in which an electric current was set up and continued to flow in a ring of lead metal so long as it was kept within about ten degrees of absolute zero. Metals undergo a transformation in their electrical resistance at these very low temperatures. The resistance practically vanishes. If a bar magnet is thrust through a ring of lead which has been cooled with liquid helium below its superconducting transition temperature, a current will then be set up in the lead which will continue to flow for as long as the lead ring is kept cold. Such a current was set in motion by workers at the University of Leyden in Holland and the whole apparatus crated and shipped to England where, before the British Physical Society some days later, the persistance of the current was demonstrated.

Davis—It sounds like perpetual motion.

McKenzie—No, Mr. Davis, for this is not a source of electrical energy but merely a demonstration of frictionless motion. We are, however, through such studies as these, learning a great deal about the properties of matter, and that is important because we never know when we are going to run into something which is of tremendous practical importance.

Montroll—As a matter of fact, Mr. McKenzie, there is one fairly practical possibility, and that is that compact but very efficient apparatus for producing liquid helium may find application upon some of our big ships such as aircraft carriers. Not only is superconductivity important but since all metals lose most of their electrical resistance at low temperatures, there is a possibility of using this property to improve the sensitivity of electronic receiver circuits,

and this is very intriguing indeed. The pilots assigned to aircraft carriers might go aloft with liquid helium in their thermos bottles instead of their hot coffee. This could be a small liquefier about the size of a baby carriage. Such a liquifier could keep three airplanes supplied with ample refrigerant for three hours.

DAVIS—I imagine that is something for the future rather than what is happening now, Dr. Montroll. But isn't the use of liquid air or liquid oxygen as a jet fuel not so very remote?

MONTROLL—There are many places in the Navy and industry where liquid oxygen is now used. For example, Kapitza, a Russian low temperature physicist has developed a technique of using liquid oxygen for the operation of blast furnaces for the making of iron. Compact and reliable air liquefiers are now available as service equipment to supply fuel for rockets and jet engines. It should be re-emphasized that basic research in the field of low temperature is our primary interest. One can never tell what application may result from basic research.

DAVIS—That is the reason, I suppose, that the Office of Naval Research is supporting very extensive research and experimentation at these low temperatures at more than a dozen universities throughout the country. I am told that the Navy's support of low temperature research is part of its broad plan of making it possible for scientists and research institutions to do work that they are best fitted to do with the assurance that out of such fundamental experiments will come many things that the Navy and the other armed services will need to keep ready for war and efficient and up-to-date in peace.

Anti-Corrosion Grease

➤ PROTECTIVE GREASES, to prevent the corrosion of metals, containing compounds of aluminum, chromium and zinc, have been found effective in Canada's National Research Laboratories at Ottawa where they were developed. In an extended test one proved more protective than others tried.

Tests made by the three chemists who developed the new grease, M. Cohen, A. C. Halferdahl and I. E. Puddington, seem to show that it is a superior protector. They tested particularly its ability to prevent corrosion of bolts and nuts in a steel plate. They immersed the plate with the bolts and nuts in sea water for eight hours, then suspended it in water-saturated atmosphere. The process was repeated daily for 10 weeks.

It was then found that bolts protected by light machine oil only had seized completely, while those covered with a lubricant oil could just be turned. Bolts to which the new grease had been applied were readily loosened by hand.

Composition of this improved grease is 2% zinc chromate, 7% aluminum stearate, stearic acid, graphite, and a common petroleum distillate.

Experiments with Chemical Angles in Eighth Science Talent Search

Science Talent Projects

For hundreds of young scientists in America's secondary schools the annual Science Talent Search is the culmination of their science studies and hobbies. Hundreds are helped on the way to their college and research careers.

In the Eighth Annual Science Talent Search which culminated in the visit of the 40 winners to Washington early in March, chemistry figures prominently in many of the projects that were submitted in making the entries.

Some of these projects are reported in the following accounts:

Fluorine and Plants

➤ IF FLUORINE is being added to the water supply in your town to protect children's teeth against decay, you need not fear to use it in sprinkling your garden or watering your potted plants. Experiments carefully carried out by John D. Kaufman, 16, a high school senior at Grinnell, Iowa, have demonstrated that in the concentrations used for decay-preventing purposes, fluorine will not harm young plants.

Mr. Kaufman used soilless gardening methods in making his tests. He planted three bean seeds each in 12 pots filled with the artificial soil known as vermiculite, and watered them with solutions containing chemically active fluorine in eight different dilutions, ranging from one to 1,000 parts per million. Three pots received dilute solutions of common salt (sodium chloride) instead of fluorine, and one pot, used as a control, received distilled water only. It was found that in a concentration between 100 and 500 parts of fluorine per million of water, sprouting was inhibited. This concentration, however, is far above the level commonly used in city water.

In a second experiment, the effects of fluorine on growth rather than on sprouting were investigated. This time the beans were allowed to sprout and grow to a height of two inches before they received water containing any fluorine. The plants were also given the necessary fertilizer elements in solution.

After five weeks, all the plants were still alive. Only those receiving the highest concentration of fluorine, 1,000 parts per million of water, were stunted. Since this concentration is hundreds of times higher than that used in drinking water anywhere, Mr. Kaufman states that "we may conclude that the use of fluorides in drinking water to check tooth decay could have no harmful effect upon the sprouting or the growth of plants."

Test for Disinfectants

➤ A NEW TEST for germ-killing chemicals, in which volunteer human guinea-pigs can be used without harm or danger to themselves, was devised by John W. Kimball, 18, a senior at Phillips Academy, Andover, Mass. In

his experiments he had the help of his classmates, who loaned him the use of the skin on their forearms in the interests of research.

Present testing methods, Mr. Kimball found, are based either on the use of the chemicals against bacterial cultures in test tubes or on the injection of the germs into the bodies of mice or other live animals. The first method, he feels, is unrealistic, while the second is often difficult and slow, and may be costly besides. It does, however, measure the effectiveness of the compounds when used against bacteria actually in contact with living tissue, which is lacking in the test-tube method.

Mr. Kimball's new method consists in swabbing a sample of the solution to be tested on a patch of relatively hair-free skin in the presence of bacteria. After a measured time interval, to give the compound a chance to act, the same area is mopped up with a moistened sterile cotton swab. The swab, with the germs it has picked up, is then thoroughly shaken out in a sterile salt solution, from which a measured sample is extracted for culturing in an incubator by standard bacteriological methods. The number of germ colonies resulting is an inverse measure of the effectiveness of the compound under test.

In one of the test series, the relatively new disinfectant, merthiolate, was found more effective against bacteria on human skin than the old stand-by, tincture of iodine. This is the reverse of results obtained by the U. S. Food and Drug Administration test-tube method. Mr. Kimball believes the discrepancy is due to the fact that iodine combines with the albumin of the skin, thereby losing effectiveness against the bacteria, whereas the merthiolate is not affected by the presence of the skin and is thus free to do the work for which it is intended.

Mass-Production of Slides

➤ ASSEMBLY-LINE methods are applied to the production of microscope slides for classroom study by William E. Kriegsman, 16, of Scarsdale, N. Y. High School. Hitherto this has been a slow, tedious hand-craft job. Mr. Kriegsman found that the thin-sliced sections could be attached with acetone to a feeder belt made of photographic film, permitting them to be carried through the necessary chemical and staining processes in large, labor-saving lots. He believes his method can be put to use in hospitals as well as schools, for the quick study of cancerous and other diagnostic materials.

Light Helps Emulsion?

➤ MARTIN B. BRILLIANT, 17, of Stuyvesant High School, New York, offered the paradoxical-seeming proposition that exposure to very weak light may actually make photographic emulsions more sensitive instead of ruining them. He developed apparatus for testing his unorthodox hypothesis, using carefully measured light intensities and exactly determined exposures. He also used his apparatus to study the difference, if any, between fogging of a film that takes place before exposure and that which occurs afterwards.

Separation of Two Elements

➤ ATOMIC-POWER piles of the future may receive the benefit of a difficult task in chemical research undertaken

by a Washington, D. C., prep-school student, Walter Gilbert, 16, of Sidwell Friends School.

Zirconium, most familiar in the form of its oxide, the gemstone zircon, has been under consideration as a possible atomic-pile material. However, as found in nature it is usually so mixed up with a much heavier but chemically similar element, hafnium, that its extraction in workably pure form has been prohibitively tedious and costly.

Mr. Gilbert obtained a supply of zirconium dioxide, and has been converting it into other compounds — hydroxide, citrate, phosphate and others — each time endeavoring to reduce the troublesome hafnium content. Most promising to date seems to be the phosphate method. The work is still in progress.

Temperature and Magnetism

➤ PROOF OF correlation between temperature and retention of magnetism in soft iron magnets has been produced by a 17-year-old student at New Brunswick, N. J., High School, Elihu A. Boldt. His experiments were performed on the dining-room table of his home, with the simplest kind of apparatus.

It has long been known, Mr. Boldt explains, that steel magnets are much more nearly permanent than soft iron ones; as a matter of fact, the latter lose their magnetism very quickly after the electric current that induces it is shut off. It is also well known that heating a steel magnet causes it to lose some of its magnetism.

These facts aroused in his mind a curiosity as to whether an opposite condition, like chilling to the temperature of dry-ice, would cause magnetism to last longer in a soft iron bar.

He placed his iron bars, with the electric coils that were to magnetize them, in insulated glass jars, which he subjected to four different temperatures: that of the room itself, the boiling and freezing points of water, and the temperature of solid carbon dioxide or dry-ice, which is almost 80 degrees below zero Centigrade. During each experiment, he placed an ordinary pocket compass near the bar, measuring the bar's loss of magnetism by the time required for the compass needle to swing away from its deflected position back to normal.

Each test was repeated 30 times, and the periods required for loss of magnetism reduced to an average. A definite correlation between retention of magnetism and lowering of temperature was demonstrated.

Experiments With Dicoumarol

➤ THE EXPERIMENTS were a complete success, yet the rabbit came out of them alive and healthy. So everybody was satisfied—including the rabbit.

The experiments in question were on the effects of the "sweet-clover drug," dicoumarol, on the clotting time of blood, in living animals. The experimenter was petite brunette Helen Claire Oels, 17, senior at Little Flower Catholic High School for Girls, Philadelphia. The research job she had laid out for herself seemed away over her head, to an older scientist on the sidelines; but she showed that she was perfectly able to carry it through.

Dicoumarol's principal effect is greatly to diminish the blood's clot-forming capacity, through destruction

of the clot-forming part of the blood, known as prothrombin. Miss Oels got her somewhat reluctant rabbit to swallow doses of dicoumarol by using a stomach tube, which she introduced by means of a simple but effective device of her own invention. Then she extracted small measured samples of its blood from the large blood vessel in one of its ears, and measured the now much-retarded clotting time with a stop-watch.

The anti-clotting effect of dicoumarol can be offset with vitamin K; and this Miss Oels proceeded to administer, again taking blood samples and checking the restored clotting time with the stop-watch.

Miss Oels' ambition is a research career in either medicine or biochemistry.

About the Talent Search

➤ FORTY FUTURE leaders in American science — nine girls and 31 boys — came to the annual Science Talent Institute, and won $11,000 in Westinghouse Science Scholarships in the finals of the Eighth Annual Science Talent Search conducted by Science Clubs of America, administered by Science Service, and made possible financially by Westinghouse Educational Foundation.

The 40 winners were chosen by a panel of judges after a nation-wide competition in which top-ranking seniors in all the public, parochial and private schools in the continental United States were invited to participate. Entrants, representing every state in the Union, totaled 16,218, of whom 2,482 completed the stiff science aptitude examination, submitted recommendations and scholarship records and wrote an essay on "My Scientific Project."

The Ninth Science Talent Search to be held during the 1949-50 school year is being anticipated and juniors in secondary schools throughout the nation start work on projects for next year. One boy or girl will receive the $2,800 Westinghouse Grand Science Scholarship ($700 per year for four years), in the Ninth STS, as in the Eighth STS. The runner-up will receive a $2,000 Westinghouse Science Scholarship. Westinghouse Science Scholarships, ranging in size from $100 to $400 and bringing the total to $11,000, will be awarded at the discretion of the judges to the rest of the winners. The scholarships may be used at any college, university or technical school of the winners' choice so that they may continue their training in science or engineering.

Chosen without regard to geographical distribution, the 40 winners of the Eighth Science Talent Search came from 32 localities in 17 states and the District of Columbia. Three states, Louisiana, Texas and Utah, had winners for the first time. This brings to 38 the total of states that have been represented by winners since 1942.

Two high schools in the United States produced more than one winner. Two boys and two girls came from the Forest Hills (N.Y.) High School, and the Bronx High School of Science in New York City sent two boys.

Exactly half of the winners this year come from schools that have never before placed winners in the annual Science Talent Search. Others among this year's winners are adding

new laurels to schools already honored by having produced winners in the past.

Of the 280 winners (40 per year) named in the first seven Science Talent Searches, 11 have come from the Bronx High School of Science and eight from Stuyvesant High School. Both schools are in New York City. Forest Hills (N.Y.) High School has sent six winners in previous contests, and four each have come from Herbert Hoover High School in Glendale, Calif., Eugene (Ore.) High School, and Shorewood (Wis.) High School. Oak Park Township High School in Oak Park, Ill., and Walton High School in New York City have each produced three winners in the past. Two Brooklyn schools, Abraham Lincoln High School and Midwood High School, have produced two winners each, as has Southwest High School in St. Louis, Mo. The following schools have had one winner each in the past seven years: Millburn (N.J.) High School, New Brunswick (N.J.) High School, Mont Pleasant High School in Schenectady, N.Y. and Mt. Lebanon High School in Pittsburgh, Pa.

Most of the winners live at home and attend their local or nearby public, parochial or private secondary schools.

Over half (60%) of the Science Talent Search trip winners rank first, second or third in their graduating classes, which range in size from 13 to 700 students. Approximately 70% of the winners' fathers and 50% of their mothers attended college. A number have parents who were born or educated abroad and some of the winners themselves are of foreign birth.

Contrary to a frequent conception of scientists the winners are not interested in science only. While most of them spend much of their spare time in science pursuits such as science clubs and individual hobbies of a scientific nature, all of them have participated in varied extracurricular interests such as music, athletics, journalism and dramatics, and all belong to social and educational organizations outside their school work.

Many of the top 40 have already chosen the lines of study and research they wish to pursue. Physics attracts eight, while nine intend to study chemistry. Three hope to enter medicine as a career and four want to be biochemists. Others plan careers in mathematics, astronomy, psychiatry, engineering, geology, psychology, biology, anthropology, ornithology, paleontology and bacteriology. All hope to do research in their respective fields.

Most of the 280 winners in the seven Science Talent Searches held since 1942 are now students in colleges or universities where they are preparing themselves for scientific careers. A total of 109 of them now have undergraduate degrees, 11 have master's degrees and one is a Ph.D. Six are already M.D.'s. A few are now employed full-time in jobs in industry or are on university teaching or research staffs. None of the 280 previous winners is more than 25 years old.

In addition to the 40 winners an honorable mentions list of 260 in the Eighth Annual Science Talent Search was announced. These high ranking

contestants were recommended to colleges and universities for their aptitude in science. They have received offers of scholarships from many institutions of higher education seeking students with talent in science.

Through an arrangement with Science Clubs of America, 18 states are conducting state Science Talent Searches concurrently with the national competition. In these 18 states all entries in the national Science Talent Search were turned over to state judging committees. From their entries they will choose state winners and award scholarships to various colleges and universities within the state. Cooperating states are: Alabama, District of Columbia, Georgia, Illinois, Indiana, Iowa, Louisiana, Massachusetts, Michigan, Minnesota, Mississippi, Montana, Pennsylvania, South Carolina, Tennessee, Virginia, West Virginia and Wisconsin.

Fabrics Bonded, Not Woven

➤ BONDED FABRICS, with fibers held together chemically rather than mechanically by the weave, have certain advantages over woven materials, including cost. R. B. Seymour, of Johnson and Johnson, and George M. Schroder of Henry H. Frede and Company, Inc. recently reported that these new products are already being made by several manufacturers under various trade names. Because of the economics involved in their production in contrast to woven fabrics, they said, the bulk of the material being produced is being used for such expendable items as towels, tape, diapers, wiping cloths, lining for clothing, napkins and hospital sheets.

Three different ways of cementing the fibers in the bonded fabrics were described by them. In one process, cotton or rayon fibers are formed into a lap or sheet, the fibers are softened by chemicals and then bonded together under pressure.

In another process, the lap or sheet is made from a blend of fibers. In this case some of the fibers can be softened sufficiently by heat to effect a bonding. In the most widely used process, solutions of plastics are added to the lap or sheet, and these plastics make the fibers adhere together.

Crystal Detects Radioactivity

➤ A CHEMICAL crystal with an important application in the detection and measurement of radioactivity, known as calcium tungstate, is now being produced in water-white pure form. Calcium tungstate, a fluorescent compound containing calcium, tungsten and oxygen, is widely used in the manufacture of luminous paints and in screens in X-ray fluoroscopy.

Single crystals of pure calcium tungstate are being "grown" in rods about one-eighth inch in cross section and up to two inches in length. Representative samples of the crystals are colorless, and clarity varies from a transparent to a slightly cloudy product. At the present time, these synthetic crystals have been made available in research quantities by Linde Air Products Co.

Stumps Yield Naval Stores
Trees Once Wasted Now Useful

Chemicals Grow on Trees

by Martha G. Morrow

➤ Chemical wealth from old pine stumps is finding its way into:

Super solvents for lacquers and waxes.

Trusty thinners for paints and varnishes.

Invaluable ingredient for synthetic camphor.

Suitable sizing for paper and paper board.

Mass manufacture of laundry soaps and soap powders.

The three basic chemicals extracted from stumps are rosin, turpentine and pine oil. They are used in products ranging from protective coatings to plastics, printing inks to shoe polish.

Within the last few years a wide variety of new uses has been developed for these materials extracted from the stump-lands of the South. An insecticide with turpentine as a basic ingredient is proving successful against cotton insects. An industrial alcohol from rosin is now commercially available.

The pines, both longleaf and slash, from which these valuable materials are extracted, grow in the South, along the Atlantic coastal plain and the Gulf coast. Although found from North Carolina to Florida, and South Carolina to Mississippi, most of the rosin and turpentine from stumps comes from Georgia and Florida.

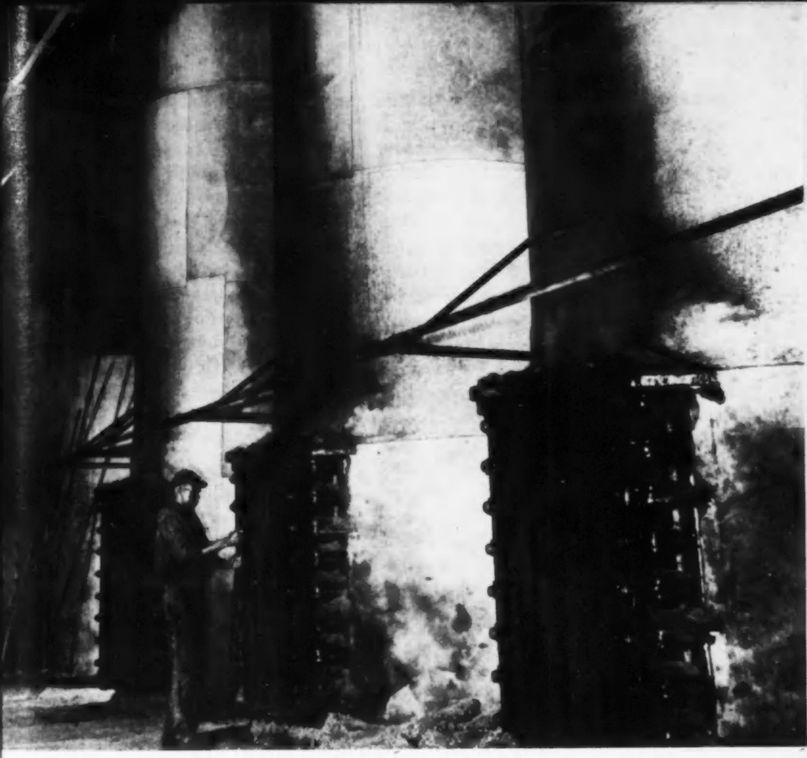
Last year more turpentine and rosin were extracted from pine stumps and fallen tree-tops than was obtained by tapping live pines. The resinified stumps and wood remaining after the sapwood has rotted off are being turned into a chemical gold mine.

Chemicals from pine trees, known today as centuries ago by the name of "naval stores," were the first products exported from what is now the United States. Turpentine, tar and pitch were first produced on this continent at Jamestown in 1608, according to the most authentic reports available.

With ax and chipper, the early settlers bled the sap from living southern yellow pines found in the vast Colonial forests. This they converted into pitch for caulking the seams of wooden sailing ships and tar for waterproofing their rigging.

Pitch and tar accounted for nearly all of the production of naval stores around George Washington's time. Today boats and shipyards use only a fraction of the total output, but the name "naval stores" still sticks. Turpentine and rosin, by far the most important products of the industry today, are used in linoleum, disinfectants, matches, adhesives and even perfumes.

Until World War I, practically all of the naval stores chemicals obtained in the United States came from the gum of living trees. But recent processes have made it practical to extract these from pine stumps and fallen pine tops.



➤ Extractors *shown here are boiler-like pieces of equipment in which chips are sealed for treatment which extracts their resinous content.*

Within the last few years the wood industry has grown to overshadow the gum industry. In 1947-48, wood turpentine amounted to 54% of the turpentine produced, and wood rosin to 58% of the rosin for naval stores. Before 1924, these accounted for less than 10% of the total production.

Pine stumps left by sawmills that ate their way through the virgin forests of the Southeastern and coastal Gulf regions offer an available and nuisance source for the chemicals. Millions of tons of roots, stumps and top wood are gathered each year.

The stumps are rooted out of the ground with bulldozers, then chopped into a better size for handling. Reaching the plant, they are washed, ground and shredded. How these large splinters and chips are handled next depends upon the process used.

The wood chips are placed in huge closed boilers in the steam-distillation

process. Steam and a solvent separate out the turpentine, pine oil, rosin and other products. The spent wood may be used either as fuel, cutting down the cost of production, or as pulp for paper making.

The basic wood is destroyed in a second process. Here the chipped stumps and fallen tops are placed in a retort, sealed to keep the air out, and heated to the charring point. The gases are driven off and condensed. This process yields wood turpentine, tars, tar oils, rosin pitch and charcoal, but no rosin.

Sulfate wood turpentine is a byproduct of paper making. It is recovered by condensing the vapors released from the pulping digesters in producing pulp from pine wood by the sulfate process. Sulfur compounds contaminate the crude byproduct, and so must be removed.

A total of 346,875 barrels—17,343,750 pounds—of wood turpentine were produced in the year ending March 31, 1948, reports the Production and Marketing Administration of the U. S. Department of Agriculture. Steam-distilled rosin production for 1947-48 amounted to 1,162,703 drums—604,605,560 pounds. This is the first time production in the United States has exceeded a million drums.

The supply of virgin stumps in the South will probably be exhausted in another 20 years or so. Then second-growth pine stumps may be worked, but not so economically — they are smaller and the rosin content relatively low.

So new methods of extracting gum from live trees are being developed. Today in many areas strips of bark are removed instead of harming the wood by cutting deep into the tree. Treating the streaks with acid or spraying them with 2,4-D has been found to increase the rate of flow and also to keep the gum flowing longer.

The largest producer of woods naval stores products is Hercules Powder Company, a leader in the search for new products and new uses. Newport Industries, Inc., recently completed a $200,000 research laboratory at Pensacola, Fla. Crosby Chemicals, Inc., is also active in the research field.

Better ways of extracting the chemical wealth from pine trees and a wider variety of uses for these products are constantly being developed. Rosin and terpene oils will continue to flow from pines, both living and dead.

Western Yellow Pine

The Southeastern Atlantic coastal region, long the source of pine pitch for turpentine, rosin and other so-called naval stores, is facing a rival in the Northwest. Millions of stumps of western yellow pine are available there, from which it is now found that pitch for naval stores can be commercially extracted.

This western yellow pine is known to foresters as *Pinus ponderosa*. It is found in the northwestern states and as far south as Arizona. It is a forest tree, attaining an age of from 300 to 500 years, and often reaching a height of over 200 feet, with stumps up to eight feet in diameter. Little if any use has been made of the stumps left after logging, but now they may be pulled and processed to obtain their pitch.

It has been long known that Ponderosa pine stumps contain pitch, but quantity, quality and costs of extraction were uncertain factors. It is now known that the pitch can be extracted commercially. This is a result of work at the Portland, Ore., laboratory of the Western Pine Association, according to American Forest Products Industries, Inc. It was found that stumps from trees cut up to four years ago yielded an average of 340 pounds per ton, and older stumps yielded 500 pounds per ton in extracts.

The process for the recovery of the Ponderosa pitch from stumps is similar to that used for the same purpose in southeastern states for some 30 years. The stumps are yanked out of the ground and hauled to factories. There they are reduced to chips by heavy machinery, and the chips are put in a solvent solution. This liquid absorbs the pitches, but is later easily separated from them. The solvent can be used over and over again.

Big, old Ponderosa stumps have been found best for processing. Their bark and sapwood, neither of which are pitchy, have been weathered away. An average aged Ponderosa pine stump on good growing land weighs a ton or more, and can yield up to 500 pounds of pitch extracts. Any number of old stumps are available in Washington, Oregon, California, Idaho, Montana and other western states. It remains now for the necessary processing factories to be constructed.

Uses Lower-Grade Timber

Trees like aspen and beech, scornfully passed up as not worth cutting in the lush days of American lumbering, are now coming into their own, it was demonstrated at the recent meeting of the Society of American Foresters. Several speakers told how these Cinderella tree species are beginning to be better appreciated, now that wood and wood products are becoming scarcer and costlier.

In the region around the Great Lakes, two-fifths of the land under timber is now covered with aspen, stated Hereford Garland, of the Michigan College of Mining and Technology, and Z. A. Zasada of the Lake States Forest Experiment Station. Hitherto it has been the policy simply to let aspen stands alone, for their water-conservation and other protective functions, but not to expect much of the species in the way of direct economic returns. However, with the growing wood hunger all over the country, a change of policy seems indicated.

A little of the timber, about 6%, can be sawed into lumber, a survey showed; 18% is in the pole timber class; the rest is classified as seedlings and saplings of varying degrees of promise. A large use in paper-pulp is possible, especially if sizes considered unsuitable for high-grade pulp are permitted to be used in the production of building paper.

Beech is another species hitherto considered secondary that is now being looked at somewhat more favorably, reported David B. Cook of the New York State Conservation Department and Ivan H. Sims of the Northeastern Forest Experiment Station. Flooring is its principal lumber use; other uses are mostly for pieces that can be handled in short lengths,

because of beechwood's troublesome tendency to warp in seasoning. The two foresters expressed the belief, however, that research will develop more effective seasoning methods, which will improve the lumber to the point where old-time prejudices against it will be overcome.

Low-grade hardwoods in the South are also coming in for more consideration. Such trees as ash, hackberry, elm and the gums, ignored when Southern lumbermen were intent only on highgrade pine, are finding scores of uses, all the way from pulpwood to small lumber. These uses were reviewed before the meeting by Paul N. Garrison, chief forester of the Gaylord Container Corporation of Bogalusa, La.

Low-grade softwoods as well as the once-despised hardwoods have begun to demonstrate their possible value in the Pacific Northwest, stated George L. Drake of the Simpson Logging Company, Shelton, Wash. In addition, removal of bark from big logs before sawing leaves slab and trimmings, once merely tossed under the boiler, ready to be chipped into material for the pulpwood digesters.

Arrow Poison Used in Throat Surgery

➤ CURARE, the poison South American Indians used generations ago on their arrows, is now being used by modern surgeons when operating on the throat. Its value in supplementing and reducing high dosages of common anesthetics was reported by Dr. R. Charles Adams of Rochester, Minn., at a recent meeting of the American Academy of Opthalmology and Otolaryngology.

Curare paralyzes reflexes. In operations on the throat, even simple ones, the gagging reflex must be abolished and ordinarily this requires very deep anesthesia. The sneeze reflex which goes into action when the surgeon touches the iris of the eye also requires deep anesthesia to abolish it.

Ether and other gases abolish these reflexes, but are often barred because of the danger that a spark from the electrocautery used in such operations might cause an explosion. Gas anesthetics present a special problem because the operations inside the throat are done in the same area where the apparatus for the anesthesia must be maintained.

Pentothal, an anesthetic which can be given by vein, eliminates these problems, but must be given in very large doses to suppress the throat reflexes. But when curare is used with it, Dr. Adams said, smaller doses of pentothal can be given. He called the combination of these two drugs a tremendous advance.

Nigeria, West Africa, raises short-haired goats and uses the hair, mixed with mud plaster, for house construction.

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